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Environmental Protection Department

Operations and Regulatory Affairs Division

Lawrence Livermore National Laboratory Experimental Test Site 300

Compliance Monitoring Program for the Closed Building 829 Facility

Annual Report 2006

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1.1 Description of Site 300

The Lawrence Livermore National Laboratory (LLNL) Site 300 (Site 300) is owned by the U.S. Department of Energy (DOE) and is operated by the University of California as an experimental test site. This site is located in the southern Altamont Hills of the Diablo Range, which is part of the Coast Range Physiographic Province. It is situated about 20 km (12 mi) east of the LLNL main site (**Figure 1**). Site 300 covers an area of approximately 30.3 km^2 (11.8 mi^2) north of Corral Hollow Road (**Figure 2**). Its elevation ranges from about 500 ft in the southeast corner to about 1750 ft in the northwest area. The western one-sixth of the site lies in Alameda County; the remaining portion is in San Joaquin County. The surrounding land is primarily agricultural. Site 300 is an active Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site.

1.2 Description of the B-829 Facility

As shown in **Figure 2**, the B-829 Facility is located in the High-Explosives (HE) Process Area Operable Unit in the south-central portion of Site 300. The B-829 Facility, part of the B-829 Complex, was used to thermally treat explosives process waste generated by operations at Site 300 and similar waste from explosives research operations at the LLNL Livermore site. The B-829 Facility was operated under the Resource Conservation and Recovery Act (RCRA) as an interim status treatment facility. Built in 1955, the B-829 Facility consisted of three separate burn pits, which were constructed in unconsolidated sediments, and an open-air burn unit. The B-829 Facility was closed in 1998, and an impervious cap was constructed over the burn pits as described in the *Final Closure Plan for the High-Explosives Open Burn Treatment Facility at Lawrence Livermore National Laboratory Experimental Test Site 300* (B-829 Final Closure Plan) (Mathews and Taffet 1997).

2.0 Post-Closure Monitoring and Inspection Activities

Monitoring and inspection of the closed burn pits during the post-closure period reflect the prime consideration: to protect human health and the environment by preventing any infiltration of rainwater that may cause the low concentrations of metals, radioactivity (i.e., gross alpha and gross beta), explosive compounds and volatile organic compounds (VOCs) in near-surface soils to migrate to groundwater. The design of the post-closure plan was originally presented in Chapter 2 of the *B-829 Final Closure Plan* (Mathews and Taffet 1997).

In January 2002, LLNL submitted a revised *Post-Closure Permit Application for the B829 Facility* (LLNL 2001) to the Department of Toxic Substances Control (DTSC). Subsequently, the DTSC issued the *Hazardous Waste Facility Post-Closure Permit for the B829 Facility* (DTSC 2003) in February 2003. This permit, effective April 3, 2003 through April 2, 2013, necessitated changes to three key areas of the monitoring and inspection activities described in the *B-829 Final Closure Plan* (Mathews and Taffet 1997).

- First, the permit directed LLNL to install one additional groundwater monitoring well within 10 ft of the boundary of the capped area. This new well (W-829-1938) and two existing wells (W-829-15 and W-829-22) constitute the groundwater monitoring locations (**Figure 3**) required by the permit.
- Second, the permit required slight modifications to the sampling plan and subsequent reporting requirements for the three wells. Perchlorate was added as a constituent of concern (COC). Both the cis- and trans-isomers of 1,2-dichloroethene (DCE) were included in the COC list, as well as total DCE. Groundwater elevations, measured at the time of sampling, are reported.
- Third, the permit specified that visual inspection of the covered area (previously performed quarterly) be conducted, at a minimum, on a monthly basis.

These required changes were implemented during calendar year (CY) 2003, and have been incorporated into the current monitoring program.

In April 2005, LLNL requested a permit modification (LLNL 2005) amending the text of the Building 829 Post Closure Operation Plan (formerly known as the "Post Closure Permit Application"). The revised operations plan reflects reductions in monitoring frequency for wells W-829-15 and W-829-22 as provided in Part III, 4(a) of the permit (DTSC 2003), and includes statistical limits for constituents of concern consistent with the data contained in the LLNL Site 300 *Compliance Monitoring Program for the Closed Building 829 Facility* Annual Report 2004 (Revelli 2005). On July 20, 2005, DTSC granted LLNL permission to implement these changes immediately (DTSC 2005).

2.1 Groundwater Monitoring

Based on groundwater samples recovered from boreholes, previous CERCLA remedial investigations determined that the perched groundwater near the B-829 Facility was contaminated with VOCs, primarily trichloroethene (TCE), but that the deeper regional aquifer was free of any contamination stemming from operation of the facility (Webster-Scholten 1994). Subsequent assays of soil samples obtained from shallow boreholes prior to closure revealed that low concentrations of HE compounds, VOCs, and metals exist beneath the burn pits

(Mathews and Taffet 1997). Conservative transport modeling indicates that the shallow contamination will not adversely impact the regional aquifer, primarily because its downward movement is blocked by more than 100 m (330 ft) of unsaturated Neroly Formation sediments that include interbeds of claystone and siltstone. At this location in the regional aquifer, the flow rate is low; an estimated 0.05 to 0.1 gallons/minute. The groundwater flow velocity is about 20 feet/year, and the direction of flow is approximately ESE.

Beginning in 1999, the dual-purpose, groundwater-monitoring program described in the *B-829 Final Closure Plan* (Mathews and Taffet 1997) was initiated for this area to track the fate of contaminants in the soil and perched water-bearing zone, and to monitor the deep regional aquifer for the unlikely appearance of any potential contaminants from the closed burn facility. This monitoring program remained in effect through the first quarter of 2003, at which time LLNL began implementation of the provisions specified in the *Hazardous Waste Facility Post-Closure Permit for the B829 Facility* (DTSC 2003). Following the guidance outlined in the DTSC *Technical Completeness* (DTSC 2002) assessment, LLNL installed one additional groundwater monitoring well at the point of compliance (POC) within 10 ft of the edge of the capped High Explosive Open Burn Treatment Facility. This well was screened in the regional aquifer, beneath the B-829 Facility. The *B829 Well Installation As-Built Diagram* (LLNL 2003) for well W-829-1938 was submitted to DTSC in November 2003. Since the first quarter of 2004, and continuing through 2006, well W-829-1938 has been used for quarterly collection of groundwater samples from the regional aquifer, as part of the permit-specified monitoring network (**Figure 3**). Also shown in **Figure 3** are two previously existing wells (W-829-15 and W-829-22), which were each sampled once in 2006, in accordance with the DTSC-approved change in sampling frequency (from quarterly to annually) for these two wells. (DTSC 2005). The data obtained during CY 2006 are discussed in **Section 3.1.**

LLNL uses statistical methods consistent with the state regulations [California Code of Regulations (CCR) Title 22, Section 66264.97(e)(8)(D)] to accomplish the monitoring and reporting provisions of the post-closure plan (Mathews and Taffet 1997). The methodology relies on our ability to establish a background concentration, which is defined as the concentration limit (CL), for each constituent of concern (COC). Additionally, statistically determined limits of concentration (SLs) for the COCs have been calculated from the monitoring data.

The CL and SL values presented in **Table 1** replicate those limits documented in the 2005 Annual Report (Revelli 2006). For wells W-829-15 and W-829-22, established before the permit (DTSC 2003) was issued, the limits were first included in the 2002 Annual Report (Revelli 2003). For well W-829-1938, developed in accordance with DTSC requirements (DTSC 2002), the CLs and SLs were first included in the 2005 Annual Report (Revelli 2006). These SL values (**Table 1**) served as the limits against which the analytical results from

2006 were compared. The SLs for most COCs in **Table 1** are given as the RLs, because the measurements are below the detection limits for those constituents.

SLs provide the basis for comparison with COC measurements in subsequent years to identify potential releases to the deep regional aquifer. If a future measurement exceeds an SL, LLNL will implement a method of data verification that involves two discrete retests, in accordance with CCR Section 66264.97(e)(8)(E). If an exceedance is confirmed by either or both of the retests, these results will be interpreted and reported as “statistically significant evidence of a release of the COC to groundwater.”

2.2 Inspection and Maintenance

The permit (DTSC 2003) requires that LLNL perform quarterly inspections of the monitoring wells and monthly visual inspections of the closed B-829 Facility (final cover cap, drainage and diversion ditches, groundwater monitoring system, signage, etc.). Additional inspections are required after major rainstorms, significant earthquakes, or other events that may cause substantial damage to the capped facility. Any deficiencies noted, such as erosion of the cover, fissures or low spots, burrowing by animals, and bare areas needing reseeding, are remediated. In addition to these inspections performed by LLNL staff, an independent, California-registered Professional Engineer (PE) must perform an annual engineering inspection. The PE prepares a written inspection report, which includes comments and recommendations, and submits that documentation to LLNL.

3.0 Results of Post-Closure Monitoring and Inspection for CY 2006

3.1 Discussion of Monitoring Results

CY 2006 analytical results for the well locations W-829-15, W-829-22, and W-829-1938 are listed in **Tables 2, 3, and 4**, respectively. The annual sampling required for wells W-829-15 and W-829-22 (DTSC 2005) was conducted during the second quarter of 2006, while well W-829-1938 was sampled quarterly. Note that all non-detections of constituents are shown in the data tables as being less than (<) the analytical reporting limit.

Appendix A presents graphical depictions of the pre-sampling groundwater elevations (GWE) and concentration trends for all confirmed COC detections above their respective RLs, for the permit-specified wells (W-829-15, W-829-22, and W-829-1938). Graphs for the two established wells (W-829-15 and W-829-22) present data accumulated over the last eight years, going back to 1999, the first year of monitoring under the *B-829 Final Closure Plan* (Mathews and Taffet 1997). The graphs for well W-829-1938, which was installed during CY 2003, present only twelve quarters of data; beginning with the first-quarter results from CY 2004.

In addition to the pre-sampling GWE measurements plotted in **Appendix A**, LLNL collects quarterly GWE measurements for the wells in this network as part of a larger, site-wide study. **Tables 2 and 3** include the results of this GWE study for the two wells in the B-829 network (W-829-15 and W-829-22) that were only sampled once during the year. The GWEs, for any given well, show almost no fluctuation across the four quarterly measurements.

The concentration trends shown in **Appendix A** generally reflect the natural background variability of the analytes detected at each of the three monitoring well locations. Only two plots, chromium at well W-829-15 and gross beta at well W-829-15, suggest that the more recent data (CY 2003 and beyond) might indicate less variable and slightly lower background values (as compared to the CLs presented in **Table 1**) for these constituents. Of the three wells in this network (W-829-15, W-829-22, and W-829-1938), W-829-15 was the first completed (March 1995) and has the longest operation history. LLNL will continue to monitor for similar trends in background concentrations at the more recently completed wells as additional data become available.

During CY 2006 there were no confirmed COC detections, above their respective SLs, in groundwater samples from any of the three monitoring wells. Among the inorganic constituents, the metal COCs that were detected in CY 2006 samples show concentrations below their respective statistical limits (the SLs shown in **Table 1**), and not significantly different from background concentrations (the CLs shown in **Table 1**) for the deep aquifer beneath the HE Process Area. Similarly, all results for gross alpha and gross beta (the radioactive COCs) were below their RL and SL values, respectively. Only the COC perchlorate was initially reported to be above its SL in one sample from well W-829-1938; however, as discussed below, this result was invalidated. Neither organic nor explosive COCs were detected in any samples at concentrations above their respective RLs.

As previously noted, the permit-specified COC perchlorate (DTSC 2003) was detected above RL in a ground water sample from one of the deep monitoring wells. The first-quarter concentration for perchlorate (SL = RL = 4.0 μg/L) from well W-829-1938 was initially reported at 4.1 μg/L (**Table 4**) and this finding was reported to the DTSC (LLNL 2006A). To confirm this result, LLNL employed a method of data validation that utilizes discrete retests and is consistent with state regulations [CCR Title 22, Section 66264.97(e)(8)(E)]. Two additional ground water samples were subsequently obtained from well W-829-1938: one on March 1, and a second on March 15. Both samples were analyzed for perchlorate using the same analytical test (EPA Method 314.0). No perchlorate was detected in either sample above the reporting limits for this constituent. According to the state-approved methodology, these two nondetections in the retest samples invalidate the earlier detection in the routine quarterly sample.

DTSC was notified that the initial detection of perchlorate was not confirmed (LLNL 2006B).

Finally, total coliform (an analyte included in the state list of water quality parameters that is not a permit-specified COC) was detected above the RL in the second and third quarter groundwater samples from well W-829-1938 (**Table 4**). No coliform bacteria were detected at this location in either the first or fourth quarter 2006 samples, and preliminary results from the first-quarter 2007 sample at W-829-1938 also show no detection of coliform. Historically, analytical results from CY 2004 showed two detections of total coliform in quarterly samples from well W-829-1938, and one quarterly sample collected at W-929-1938 in 2005 also indicated the presence of total coliform bacteria. These detections were only for the total coliform group, a large collection of different kinds of bacteria commonly found in the environment. Fecal coliform bacteria, a sub-group of the total coliform group, have not been detected above reporting limits in any of the samples collected from the wells in this network.

3.2 Inspection of the B-829 Facility

During CY 2006, LLNL staff completed twelve monthly post-closure inspections of the covered area at the B-829 Facility. The inspection checklist form, used during these LLNL inspections, is provided in **Figure 4.** The checklist form used to document the monitoring well inspections, which are required quarterly (see below), is shown in **Figure 5.** All completed forms are retained for three years by the LLNL Environmental and Special Projects Manager at Site 300.

On April 12, 2006, DTSC conducted an inspection of LLNL Site 300 and identified two violations related to the B-829 Facility. The first violation, identified in the DTSC Summary of Violations, found that on or about the third quarter of 2005 and the first quarter of 2006, LLNL "failed to follow the facility's operation plan to conduct the quarterly inspection for wells" (DTSC 2006A). LLNL has provided DTSC with a signed certification to correct this violation by "ensuring the B-829 monitoring wells W-829-15, W-829-22, and W-829-1938 are inspected quarterly as required by the post-closure permit" (LLNL 2006C). The second violation, identified in the DTSC Compliance Evaluation Inspection Report, found that on or about October 5, 2005 and April 6, 2006, LLNL "failed to record on the inspection log the time of the inspection" (DTSC 2006B). LLNL has corrected this violation by recording the time of inspection on the B-829 Monitoring Well Inspection Checklist next to the "inspection date" entry (LLNL 2006D). Based on these responses from LLNL, DTSC has determined that the violations have been appropriately remedied. Compliance will be verified during the next inspection (DTSC 2007).

Finally, the required annual cap inspection by a California-registered Professional Engineer was completed on May 24, 2006. [A copy of the *LLNL Site 300 Building 829 Landfill Cap Annual Engineering Inspection* (Moore 2006) is included in this report as **Appendix B**.] The inspection included a review of existing documentation on the cap as well as an on-site inspection. With one exception (i.e., some evidence of burrowing), all items required to be inspected under Title 22 of the CCR, Part 66264.228(k), were noted to be in good condition. The annual engineering inspection report contains one recommendation, fill in the animal holes exceeding 18 in. in depth and 6 in. in diameter on the cap and reseed where necessary, which was addressed by the Site 300 Manager's Office during the third quarter of CY 2006.

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Table 1. Constituents of concern, typical analytical reporting limit (RL), background concentration limit (CL)[a], and statistical limit (SL)[b] for B-829 Facility monitoring wells W-829-15, W-829-22, and W-829-1938.

Constituent of concern	Typical analytical RL	Unit of measure	Well W-829-15		Well W-829-22		Well W-829-1938	
			CL	SL	CL	SL	CL	SL
Antimony	5	μg/L	<RL	RL	<RL	RL	<RL	RL
Arsenic	2	μg/L	17	22	<2.9	2.9	26	42
Barium	25	μg/L	26	75	<RL	RL	22	30
Beryllium	0.5	μg/L	<RL	RL	<RL	RL	<RL	RL
Cadmium	0.5	μg/L	<RL	RL	<RL	RL	<RL	RL
Chromium	1	μg/L	2.2	7.8	0.9	1.5	0.8	3.9
Cobalt	25	μg/l	<RL	RL	<RL	RL	<RL	RL
Copper	10	μg/L	<RL	RL	<RL	RL	<RL	RL
Lead	2	μg/L	<RL	RL	<RL	RL	<RL	RL
Manganese	10	μg/L	<RL	RL	<RL	RL	63	150
Mercury	0.2	μg/L	<RL	RL	<RL	RL	<RL	RL
Molybdenum	25	μg/L	24	27	<RL	RL	23	32
Nickel	5	μg/L	<RL	RL	<RL	RL	4.9	19
Selenium	2	μg/L	<RL	RL	<RL	RL	<RL	RL
Silver	0.5	μg/L	<RL	RL	<RL	RL	<RL	RL
Vanadium	25	μg/L	<RL	RL	<RL	RL	<RL	RL
Zinc	20	μg/L	<RL	RL	<RL	RL	11	30
Perchlorate	4	μg/L	<RL	RL	<RL	RL	<RL	RL

(continued)

Table 1. Constituents of concern, typical analytical reporting limit (RL), background concentration limit (CL)[a], and statistical limit (SL)[b] for B-829 Facility monitoring wells W-829-15, W-829-22, and W-829-1938 (concluded).

Constituent of concern	Typical analytical RL	Unit of measure	Well W-829-15		Well W-829-22		Well W-829-1938	
			CL	SL	CL	SL	CL	SL
1,1,1-Trichloroethane	1	µg/L	<RL	RL	<RL	RL	<RL	RL
1,1-Dichloroethene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
1,2-Dichloroethane	1	µg/L	<RL	RL	<RL	RL	<RL	RL
cis-1,2-Dichloroethene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
trans-1,2-Dichloroethene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
1,2-Dichloroethene (total)	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Benzene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Carbon disulfide	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Chloroform	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Dichlorodifluoromethane	2	µg/L	<RL	RL	<RL	RL	<RL	RL
Ethylbenzene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Freon 113	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Tetrachloroethene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Toluene	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Total xylene isomers	2	µg/L	<RL	RL	<RL	RL	<RL	RL
Trichloroethene	0.5	µg/L	<RL	RL	<RL	RL	<RL	RL
Trichlorofluoromethane	1	µg/L	<RL	RL	<RL	RL	<RL	RL
Bis (2-ethylhexyl) phthalate	5	µg/L	<RL	RL	<RL	RL	<RL	RL
Phenols	5	µg/L	<RL	RL	<RL	RL	<RL	RL
HMX	1.0	µg/L	<RL	RL	<RL	RL	<RL	RL
RDX	1.0	µg/L	<RL	RL	<RL	RL	<RL	RL
TNT	5.0	µg/L	<RL	RL	<RL	RL	<RL	RL
Gross alpha	0.074	Bq/L	0	0.123	0	RL	0.01	0.11
Gross beta	0.11	Bq/L	1.81	3.77	0.27	0.43	0.42	0.55

[a] CL is defined as the average background concentration of a COC.

[b] SL is defined as the concentration of a COC, above which an exceedance occurs.

Table 2. B-829 area deep well W-829-15, monitoring results for year 2006.
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006 1/31/2006 [c]	4/6/2006	7/27/2006 [c]	10/30/2006 [c]
General (units)						
Groundwater elevation (feet)			697	697	697	697
pH (pH Units)		X		8.29		
Specific conductance (μmho/cm)		X		1038		
Inorganic (μg/L)						
Antimony	X			< 5		
Arsenic	X	X		16		
Barium	X	X		49		
Beryllium	X			< 0.5		
Cadmium	X	X		< 0.5		
Chromium	X	X		< 1		
Cobalt	X			< 25		
Copper	X			< 10		
Iron		X		< 50		
Lead	X	X		< 2		
Manganese	X	X		< 10		
Mercury	X	X		< 0.2		
Molybdenum	X			< 25		
Nickel	X			< 5		
Selenium	X	X		< 2		
Silver	X			< 0.5		
Vanadium	X			< 25		
Zinc	X			< 20		
Perchlorate	X			< 4		
Chloride (mg/L)		X		93		
Fluoride (mg/L)		X		0.30		
Nitrate (as NO_3) (mg/L)		X		< 0.5		
Sodium (mg/L)		X		170		
Sulfate (mg/L)		X		190		
Turbidity (NT Units)		X		0.15		
Organic (μg/L)						
1,1,1-Trichloroethane	X			< 1		
1,1-Dichloroethene	X			< 1		
1,2-Dichloroethane	X			< 1		
cis-1,2-Dichloroethene	X			< 1		
trans-1,2-Dichloroethene	X			< 1		
1,2-Dichloroethene (total)	X			< 1		
Benzene	X			< 1		
Carbon disulfide	X			< 1		
Chloroform	X			< 1		
Dichlorodifluoromethane	X			< 2		
Ethylbenzene	X			< 1		
Freon 113	X			< 1		
Tetrachloroethene	X			< 1		
Toluene	X			< 1		
Total xylene isomers	X			< 2		
Trichloroethene	X			< 0.5		
Trichlorofluoromethane	X			< 1		

(continued)

Table 2. B-829 area deep well W-829-15, monitoring results for year 2006 (concluded).
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006			
			1/31/2006 [c]	4/6/2006	7/27/2006 [c]	10/30/2006 [c]
BHC, gamma isomer (Lindane)		X		< 0.050		
Bis(2-ethylhexyl)phthalate	X			< 5		
Endrin		X		< 0.10		
Phenol	X	X		< 5		
Total organic halides (TOX)		X		< 20		
Total organic carbon (TOC) (mg/L)		X		< 1		
Total coliform (MPN/100 mL)		X		< 2		
Methoxychlor		X		< 0.50		
Toxaphene		X		< 2.0		
2,4-D		X		< 1.0		
2,4,5 TP (Silvex)		X		< 0.20		
Explosive (μg/L)						
HMX	X			< 1		
RDX	X			< 1		
TNT	X			< 5		
Radioactive (Bq/L)[d]						
Gross alpha	X	X		0.003 ± 0.09		
Gross beta	X	X		1.06 ± 0.24		
Radium 226		X		0.007 ± 0.004		

[a] Column A denotes permit-specified constituents of concern (COCs) for the deep regional aquifer (DTSC 2003).

[b] Column B denotes California state-specified background water quality parameters [22 CCR 66265.97(e) (16)].

[c] No sampling required other than measurement of groundwater elevation (GWE).

[d] Radioactivity results in Becquerels/liter (Bq/L) are shown as the reported sample radioactivity and associated 2σ counting errors.
(Divide these values by 0.037 to convert them to picocuries/liter.)
The reported value is negative when the measured sample radioactivity is less than the measured background activity.
The result is zero when the measured sample radioactivity is equal to the measured background activity.

Table 3. B-829 area deep well W-829-22, monitoring results for year 2006.
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006			
			1/31/2006 [c]	4/19/2006	7/27/2006 [c]	10/30/2006 [c]
General (units)						
Groundwater elevation (feet)			653	653	653	653
pH (pH units)		X		8.46		
Specific conductance (μmho/cm)		X		1057		
Inorganic (μg/L)						
Antimony	X			< 5		
Arsenic	X	X		< 2		
Barium	X	X		< 25		
Beryllium	X			< 0.5		
Cadmium	X	X		< 0.5		
Chromium	X	X		< 1		
Cobalt	X			< 25		
Copper	X			< 10		
Iron		X		< 50		
Lead	X	X		< 2		
Manganese	X	X		< 10		
Mercury	X	X		< 0.2		
Molybdenum	X			< 25		
Nickel	X			< 5		
Selenium	X	X		< 2		
Silver	X			< 0.5		
Vanadium	X			< 25		
Zinc	X			< 20		
Perchlorate	X			< 4		
Chloride (mg/L)		X		110		
Fluoride (mg/L)		X		0.42		
Nitrate (as NO_3) (mg/L)		X		< 0.5		
Sodium (mg/L)		X		220		
Sulfate (mg/L)		X		170		
Turbidity (NT Units)		X		0.1		
Organic (μg/L)						
1,1,1-Trichloroethane	X			< 1		
1,1-Dichloroethene	X			< 1		
1,2-Dichloroethane	X			< 1		
cis-1,2-Dichloroethene	X			< 1		
trans-1,2-Dichloroethene	X			< 1		
1,2-Dichloroethene (total)	X			< 1		
Benzene	X			< 1		
Carbon disulfide	X			< 1		
Chloroform	X			< 1		
Dichlorodifluoromethane	X			< 2		
Ethylbenzene	X			< 1		
Freon 113	X			< 1		
Tetrachloroethene	X			< 1		
Toluene	X			< 1		
Total xylene isomers	X			< 2		
Trichloroethene	X			< 0.5		
Trichlorofluoromethane	X			< 1		

(continued)

Table 3. B-829 area deep well W-829-22, monitoring results for year 2006 (concluded).
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006 1/31/2006 [c]	4/19/2006	7/27/2006 [c]	10/30/2006 [c]
BHC, gamma isomer (Lindane)		X		< 0.050		
Bis(2-ethylhexyl)phthalate	X			< 5.0		
Endrin		X		< 0.10		
Phenol	X	X		< 5.0		
Total organic halides (TOX)		X		< 20		
Total organic carbon (TOC) (mg/L)		X		< 1		
Total coliform (MPN/100 mL)		X		< 2		
Methoxychlor		X		< 0.50		
Toxaphene		X		< 2.0		
2,4-D		X		< 1.0		
2,4,5 TP (Silvex)		X		< 0.20		
Explosive (μg/L)						
HMX	X			< 1		
RDX	X			< 1		
TNT	X			< 5		
Radioactive (Bq/L)[d]						
Gross alpha	X	X		-0.068 ± 0.067		
Gross beta	X	X		0.29 ± 0.07		
Radium 226		X		0.001 ± 0.004		

[a] Column A denotes permit-specified constituents of concern (COCs) for the deep regional aquifer (DTSC 2003).

[b] Column B denotes California state-specified background water quality parameters [22 CCR 66265.97(e) (16)].

[c] No sampling required other than measurement of groundwater elevation (GWE).

[d] Radioactivity results in Becquerels/liter (Bq/L) are shown as the reported sample radioactivity and associated 2σ counting errors.
(Divide these values by 0.037 to convert them to picocuries/liter.)
The reported value is negative when the measured sample radioactivity is less than the measured background activity.
The result is zero when the measured sample radioactivity is equal to the measured background activity.

Table 4. B-829 area deep well W-829-1938, monitoring results for year 2006.
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006			
			1/12/2006	4/20/2006	7/13/2006	10/12/2006
General (units)						
Groundwater elevation (feet)			705	706	706	706
pH (pH units)		X	7.03	7.58	7.78	7.62
Specific conductance (μmho/cm)		X	1078	1047	1044	1059
Inorganic (μg/L)						
Antimony	X		< 5	< 5	< 5	< 5
Arsenic	X	X	23	23	31	25
Barium	X	X	< 25	< 25	25	26
Beryllium	X		< 0.5	< 0.5	< 0.5	< 0.5
Cadmium	X	X	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	X	X	< 1	< 1	< 1	< 1
Cobalt	X		< 25	< 25	< 25	< 25
Copper	X		< 10	< 10	< 10	< 10
Iron		X	< 50	< 50	< 50	< 50
Lead	X	X	< 2	< 2	< 2	< 2
Manganese	X	X	45	13	52	43
Mercury	X	X	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	X		< 25	< 25	< 25	< 25
Nickel	X		< 5	< 5	< 5	< 5
Selenium	X	X	< 2	< 2	< 2	< 2
Silver	X		< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	X		< 25	< 25	< 25	< 25
Zinc	X		< 20	< 20	< 20	< 20
Perchlorate	X		**4.1**[c]	< 4	< 4	< 4
Chloride (mg/L)		X	98	98	99	95
Fluoride (mg/L)		X	0.42	0.34	0.16	0.17
Nitrate (as NO_3) (mg/L)		X	5.0	4.2	2.1	2.6
Sodium (mg/L)		X	160	160	160	150
Sulfate (mg/L)		X	200	200	200	190
Turbidity (NT Units)		X	< 0.10	0.21	0.45	0.23
Organic (μg/L)						
1,1,1-Trichloroethane	X		< 1	< 1	< 1	< 1
1,1-Dichloroethene	X		< 1	< 1	< 1	< 1
1,2-Dichloroethane	X		< 1	< 1	< 1	< 1
cis-1,2-Dichloroethene	X		< 1	< 1	< 1	< 1
trans-1,2-Dichloroethene	X		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	X		< 1	< 1	< 1	< 1
Benzene	X		< 1	< 1	< 1	< 1
Carbon disulfide	X		< 1	< 1	< 1	< 1
Chloroform	X		< 1	< 1	< 1	< 1
Dichlorodifluoromethane	X		< 2	< 2	< 2	< 2
Ethylbenzene	X		< 1	< 1	< 1	< 1
Freon 113	X		< 1	< 1	< 1	< 1
Tetrachloroethene	X		< 1	< 1	< 1	< 1
Toluene	X		< 1	< 1	< 1	< 1
Total xylene isomers	X		< 2	< 2	< 2	< 2
Trichloroethene	X		< 0.5	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	X		< 1	< 1	< 1	< 1

(continued)

Table 4. B-829 area deep well W-829-1938, monitoring results for year 2006 (concluded).
(Constituent detections, when printed in bold, are discussed in the text.)

Constituents	A[a]	B[b]	Sampling dates 2006 1/12/2006	4/20/2006	7/13/2006	10/12/2006
BHC, gamma isomer (Lindane)		X	< 0.050	< 0.050	< 0.050	< 0.050
Bis(2-ethylhexyl)phthalate	X		< 5	< 5	< 5	< 5
Endrin		X	< 0.10	< 0.10	< 0.10	< 0.10
Phenol	X	X	< 5	< 5	< 5	< 5
Total organic halides (TOX)		X	< 20	< 20	< 20	< 20
Total organic carbon (TOC) (mg/L)		X	< 1	< 1	< 1	< 1
Total coliform (MPN/100 mL)		X	< 2	**≥ 1600**	**40**	< 2
Methoxychlor		X	< 0.50	< 0.50	< 0.50	< 0.50
Toxaphene		X	< 2.0	< 2.0	< 2.0	< 2.0
2,4-D		X	< 1.0	< 1.0	< 1.0	< 1.0
2,4,5 TP (Silvex)		X	< 0.20	< 0.20	< 0.20	< 0.20
Explosive (μg/L)						
HMX	X		< 1	< 1	< 1	< 1
RDX	X		< 1	< 1	< 1	< 1
TNT	X		< 5	< 5	< 5	< 5
Radioactive (Bq/L)[d]						
Gross alpha	X	X	-0.041 ± 0.041	-0.044 ± 0.059	0.010 ± 0.04	-0.118 ± 0.06
Gross beta	X	X	0.42 ± 0.09	0.47 ± 0.11	0.42 ± 0.09	0.41 ± 0.09
Radium 226		X	0.003 ± 0.003	-2E-04 ± 0.004	0.005 ± 0.004	0.002 ± 0.003

[a] Column A denotes permit-specified constituents of concern (COCs) for the deep regional aquifer (DTSC 2003).

[b] Column B denotes California state-specified background water quality parameters [22 CCR 66265.97(e) (16)].

[c] Analytical results from two discrete retests each showed the concentration of this COC to be less than the RL. The initial detection was not confirmed.

[d] Radioactivity results in Becquerels/liter (Bq/L) are shown as the reported sample radioactivity and associated 2σ counting errors. (Divide these values by 0.037 to convert them to picocuries/liter.) The reported value is negative when the measured sample radioactivity is less than the measured background activity. The result is zero when the measured sample radioactivity is equal to the measured background activity.

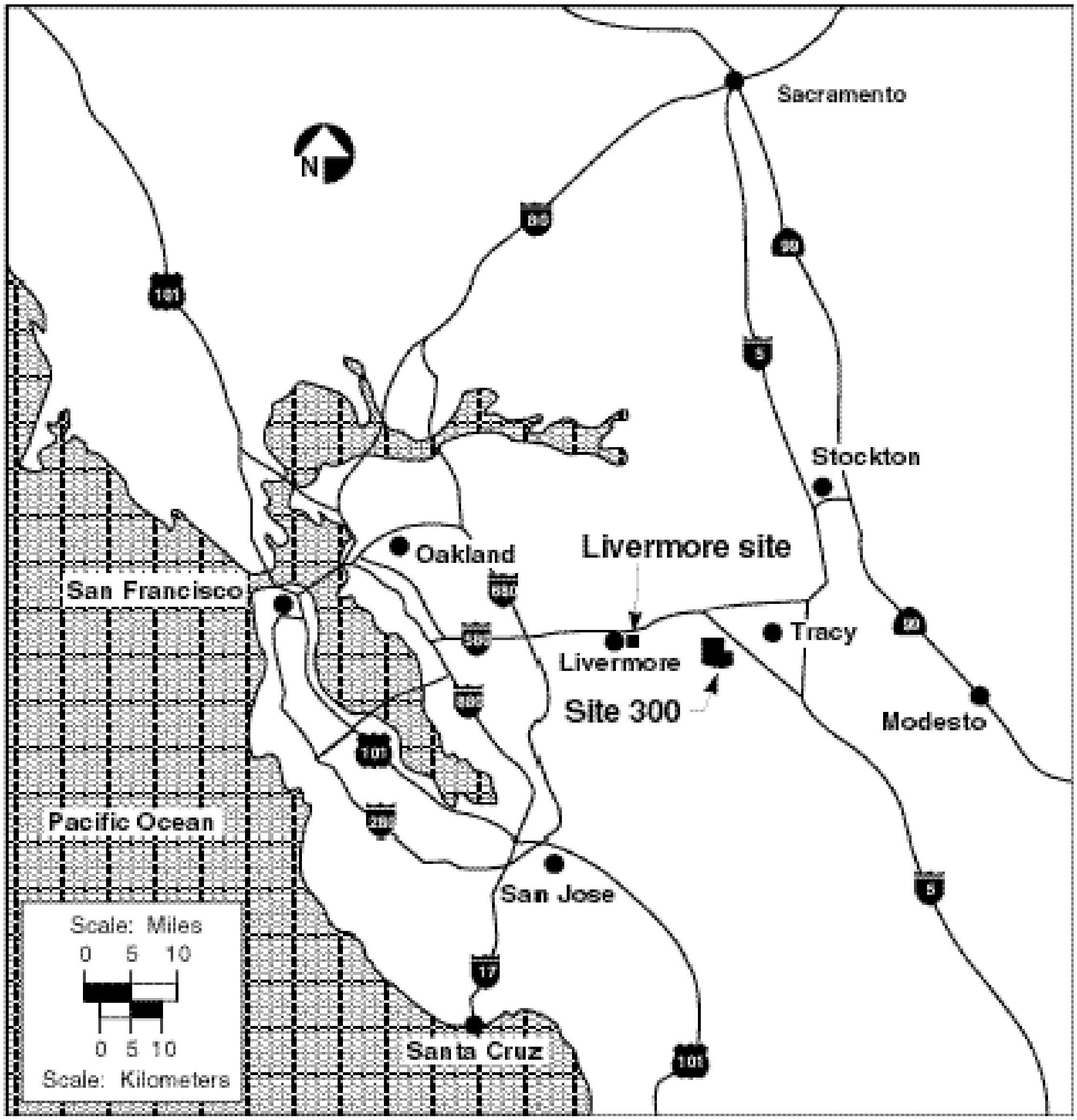


Figure 1. Locations of LLNL Livermore site and Site 300.

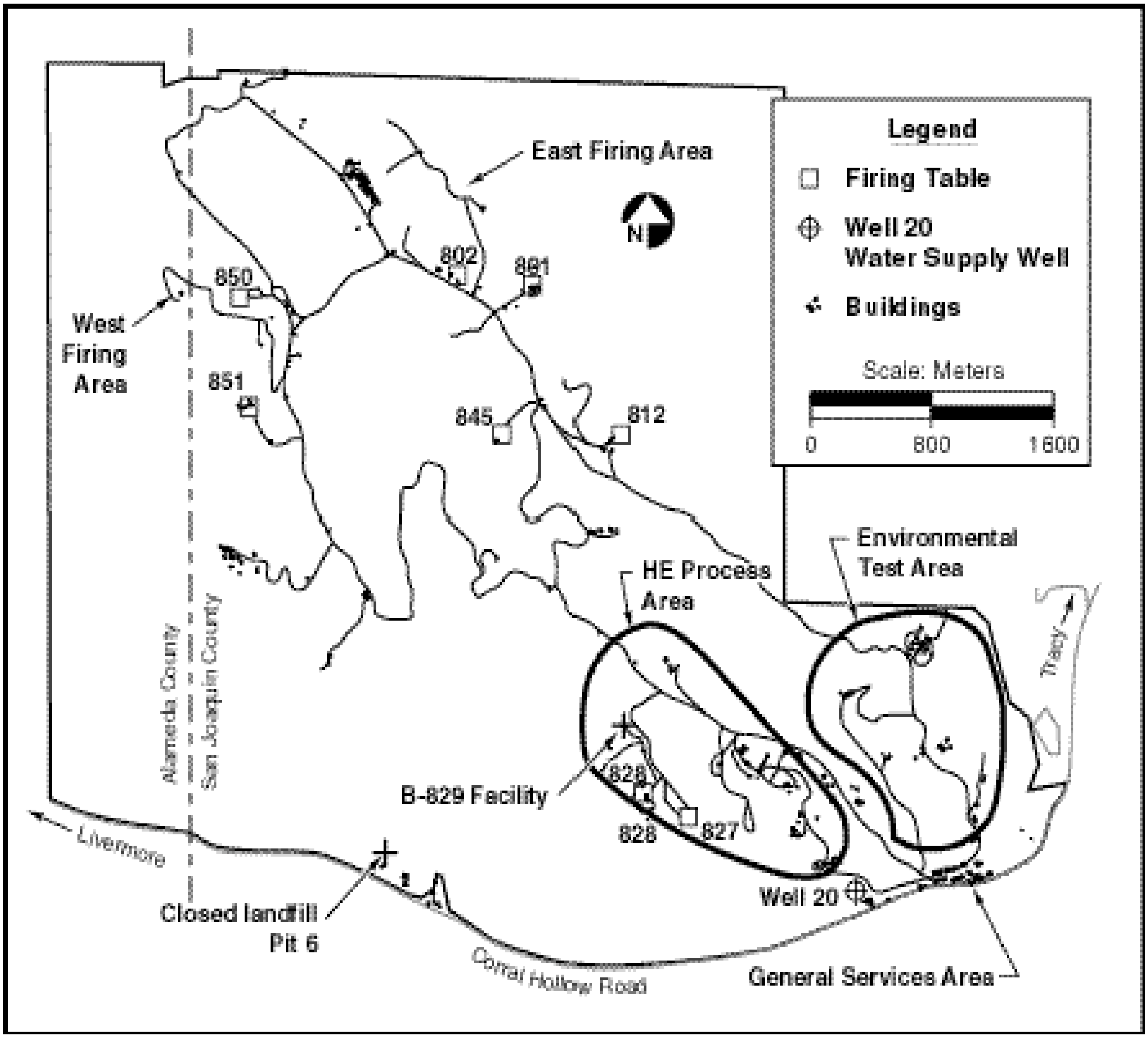


Figure 2. Location of the closed B-829 Facility at LLNL Site 300.

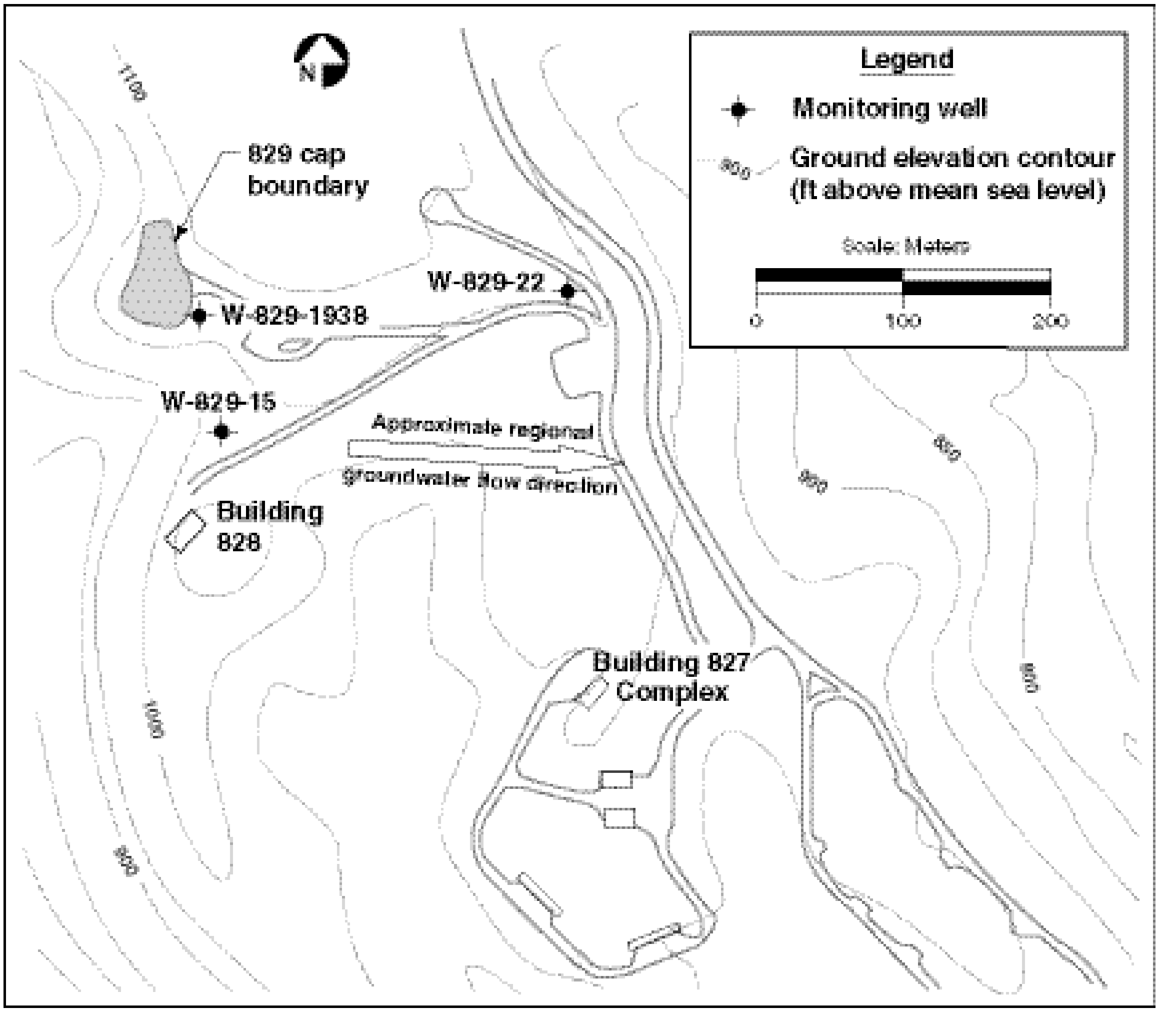


Figure 3. Location of the closed B-829 Facility and monitoring wells at LLNL Site 300.

Location: ______________________ Inspector's name: ______________________________

Date: __________________________Inspector's signature: ___________________________

Time: _________________________

Condition of the facility	Condition as described?	If correction needed, describe condition and needed repairs.	Corrections completed?	Date completed
DESCRIPTION	**Y/N**	**INSPECTOR'S COMMENTS**	**Y/N**	**DATE**
1. Cap is in good condition.				
a. Settlement or gullying observed?				
b. Surface erosion visible?				
c. Fissures visible?				
d. Cracks visible?				
e. Low spots visible?				
f. Animal burrows visible?				
g. Bare spots observed?				
h. Subsidence observed?				
i. Vegetation beyond topsoil layer observed?				
2. Runoff is diverted away from HE Open Burn Treatment Facility.				
3. Erosion controls are present and in good condition (i.e, grading, vegetation, and clear diversion channels).				
4. Permanent, surveyed benchmarks are present and maintained.				
5. Groundwater monitoring network is in good working order.				
a. Well label is intact and legible.				
b. Surface seal is intact.				
c. No evidence of damage (i.e, settlement, pipe tilting, poor protective pipe condition, standing water around the pipe, etc.) is observed.				
6. Warning sign is in place.				
7. Emergency Coordinator's name and phone number posted.				
8. Communications are in good working order.				
9. Access available to emergency vehicles.				
10. Copy of Post-Closure Plan is on file at Site 300.				
11. Other observations attached.				

Figure 4. B-829 Facility post-closure inspection checklist.

Well No.	Is Well No. clearly marked?	Is surface seal intact?	Is well capped & locked?	Is there evidence of damage?	Is there settlement?	Is there standing water?	Is reference point marked?	Comments
829-15								
829-22								
New well								

Form date: 4/17/03, rev.0

Inspection date: ______________________

Inspector name: ______________________**Signature:**______________________

Figure 5. B-829 Facility monitoring well inspection checklist.

Appendix A

Groundwater Elevation and COC Concentration Plots

Appendix A

Groundwater Elevation and COC Concentration Plots

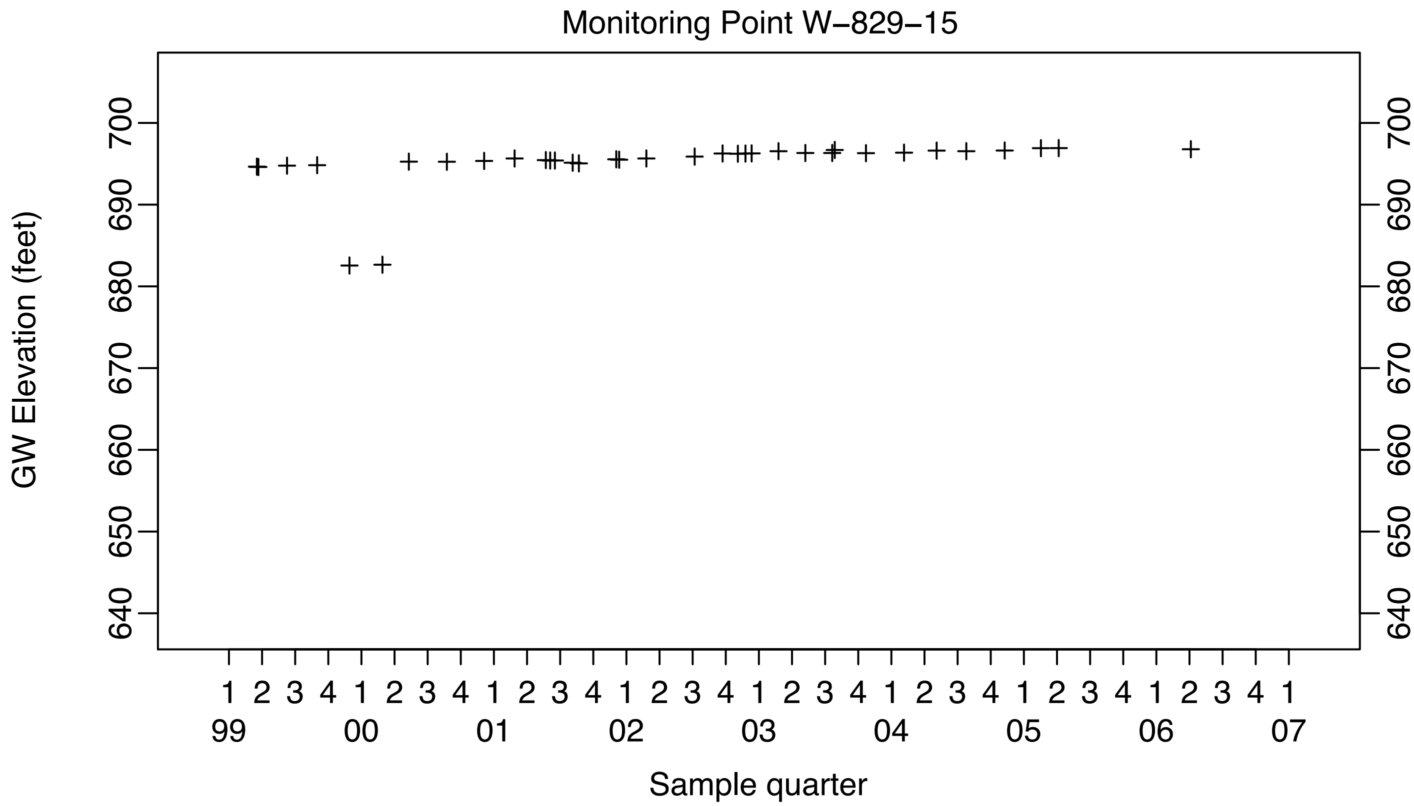
As required by the monitoring and reporting provisions of 22 CCR 66264.97(e), this appendix presents graphical depictions of groundwater elevations and concentration trends. Concentration-versus-time plots have been prepared for all confirmed constituent of concern (COC) detections above their respective analytical reporting limits (RLs), for the permit-specified wells. The graphs for the two established wells (W-829-15 and W-829-22) present data accumulated over the last eight years, going back to 1999, showing post-closure trends since the first year of monitoring under the *B-829 Final Closure Plan* (Mathews and Taffet 1997). The graphs for well W-829-1938, first monitored in CY 2004, present the twelve quarters of data available.

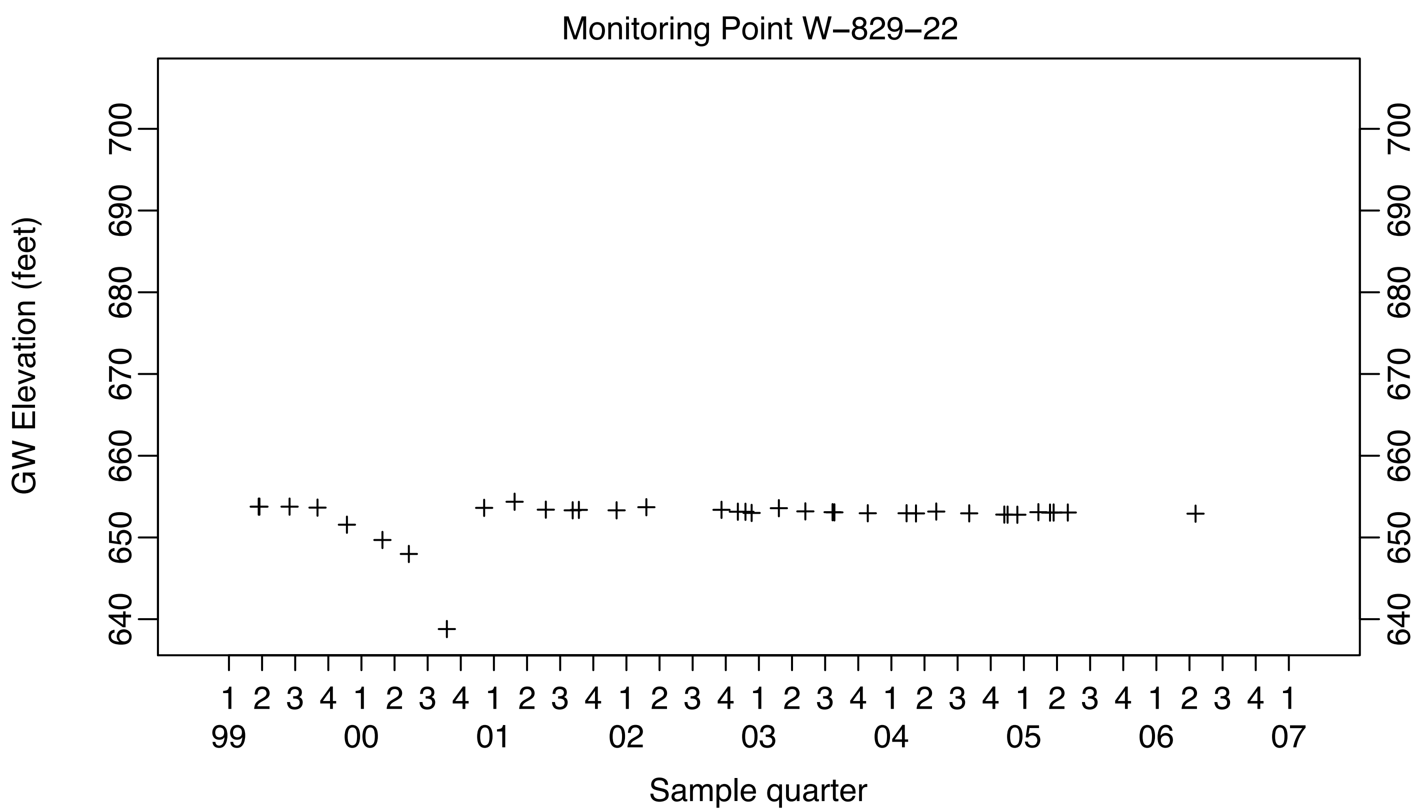
The sequence of graphs is by parameter (groundwater elevation, concentration, or activity) and by well. Graphs show the reported parameter on the y-axis, with time on the x-axis (time in years is divided into quarterly sample periods). The header and the vertical axis labels on each plot give the units of measurement. Statistical limits of concentration (SLs) are shown on the COC graphs as horizontal dotted lines. The numerical value of an SL is also given in the plot legend. Three different symbols are used to plot the COC data: a black diamond, an inverted white triangle, and a plus sign. Their different uses are explained below.

COC detections are plotted as black diamonds. Analytical laboratories report COC measurements above RLs as detections. (The RL for a COC is a contractual concentration value near zero.) COC concentrations below RLs are non-detections and are reported as “less than the RL.” For non-radioactive COCs, non-detections are assigned RL values and appear as inverted white triangles in the data graphs.

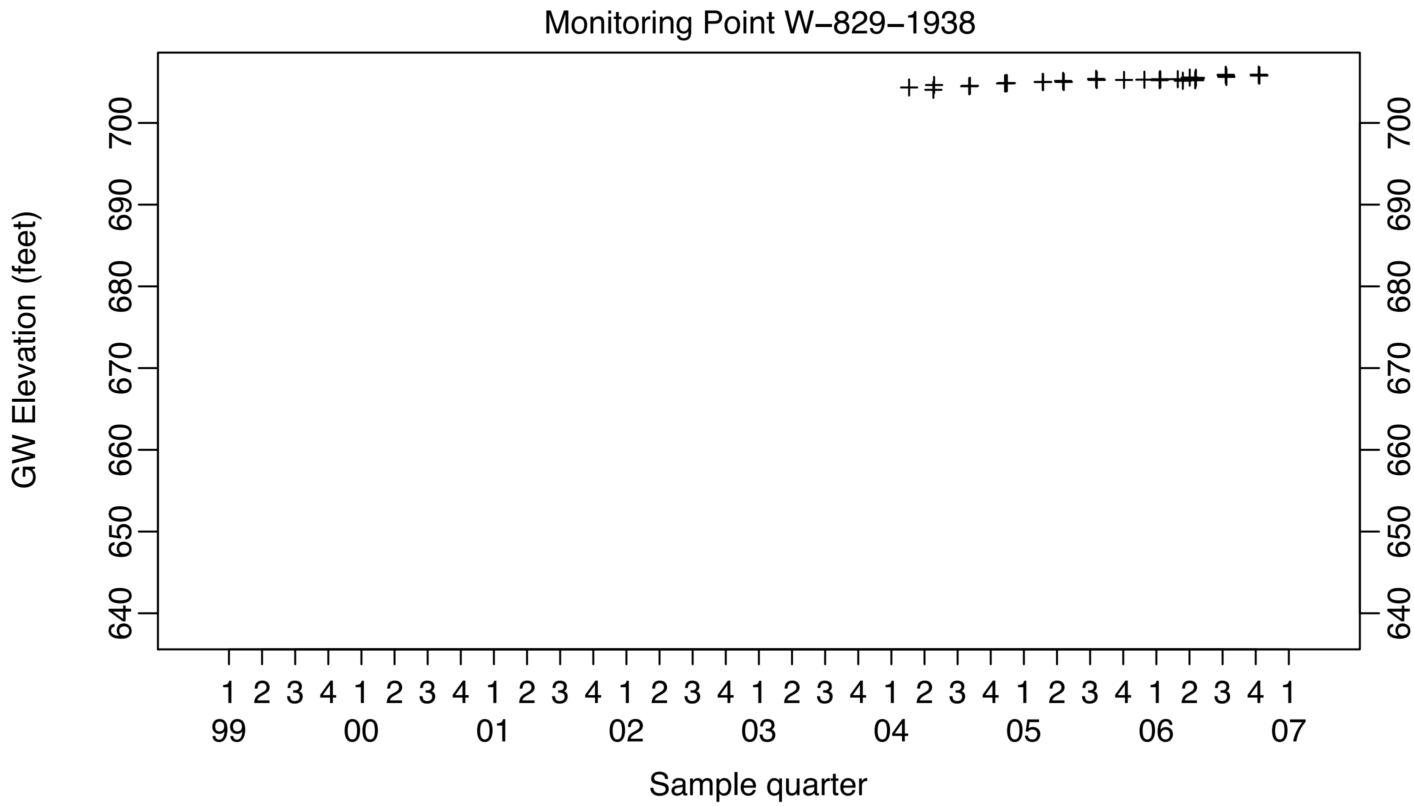
Non-detections of radioactive COCs, however, are treated differently. The reported value for radioactive COCs is the measured sample radioactivity minus the measured background radioactivity. When the result of this calculation is less than the RL, the value is plotted as a plus sign, indicating an estimated non-detection. (Note that the calculated value may be negative, or zero, if the measured sample radioactivity is less than, or equal to, the measured background activity.) When the reported activity is greater than the RL, the value is plotted as a black diamond, indicating a radioactive COC detection.

Building 829
GW Elevation (feet)

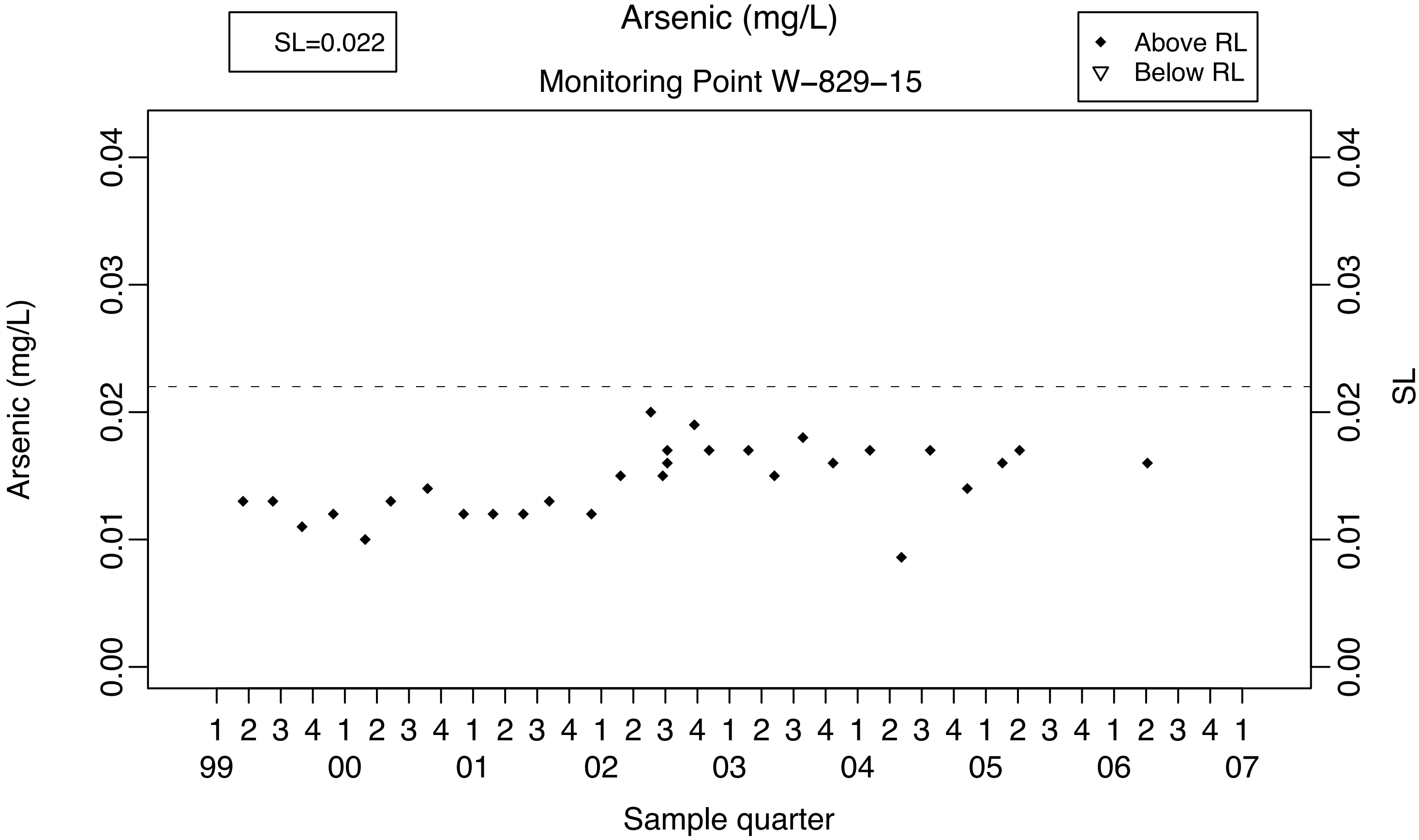


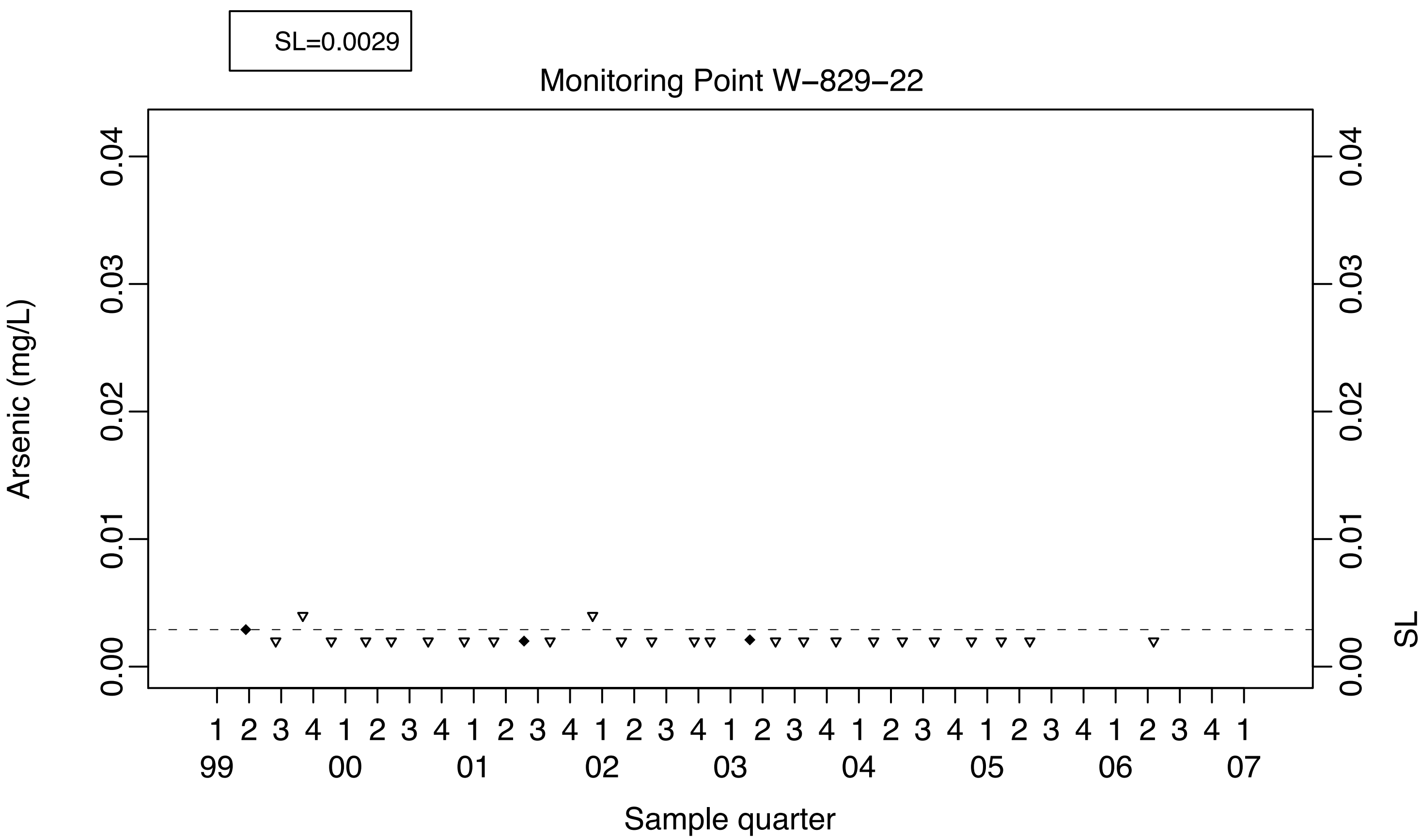


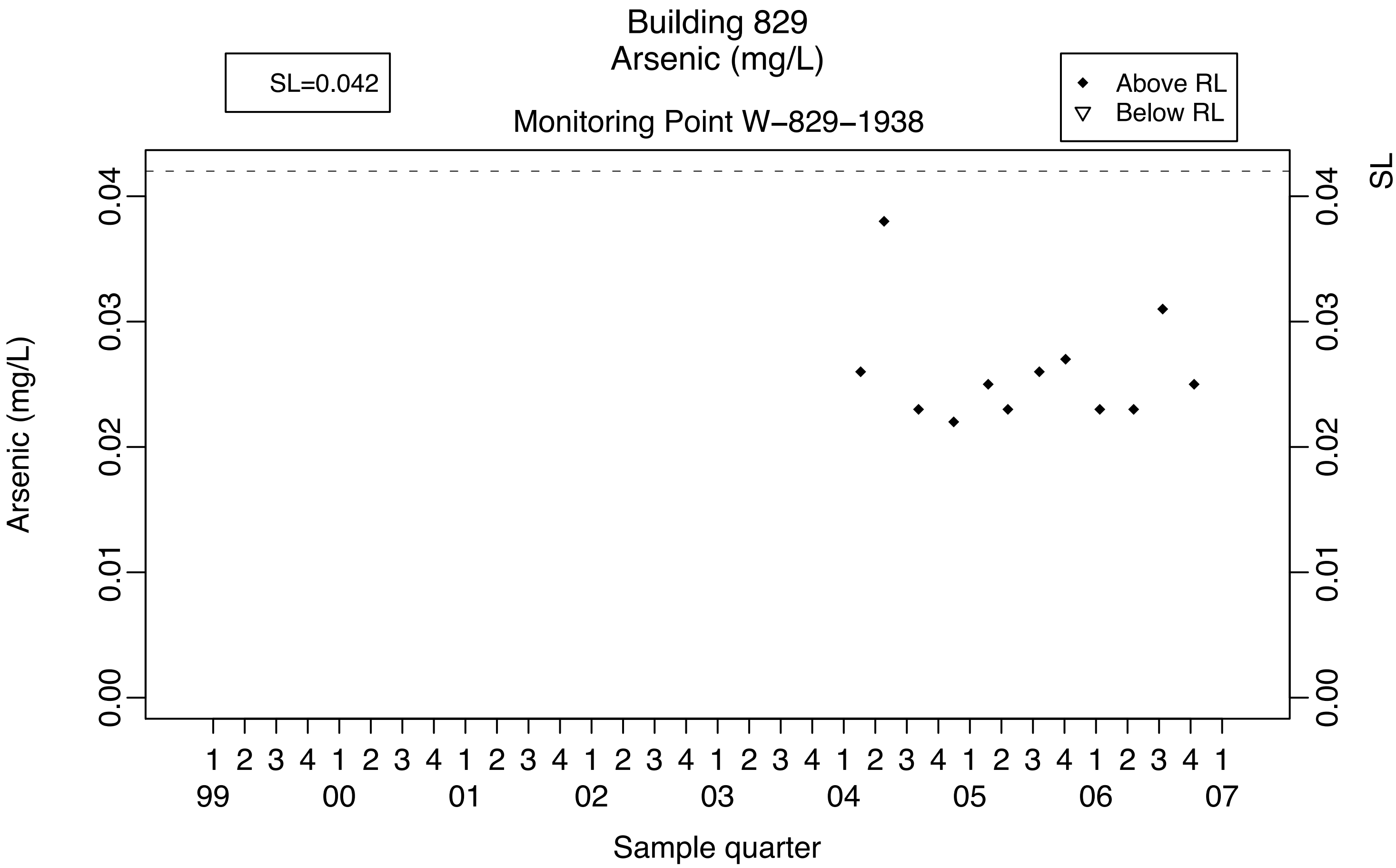
Building 829
GW Elevation (feet)

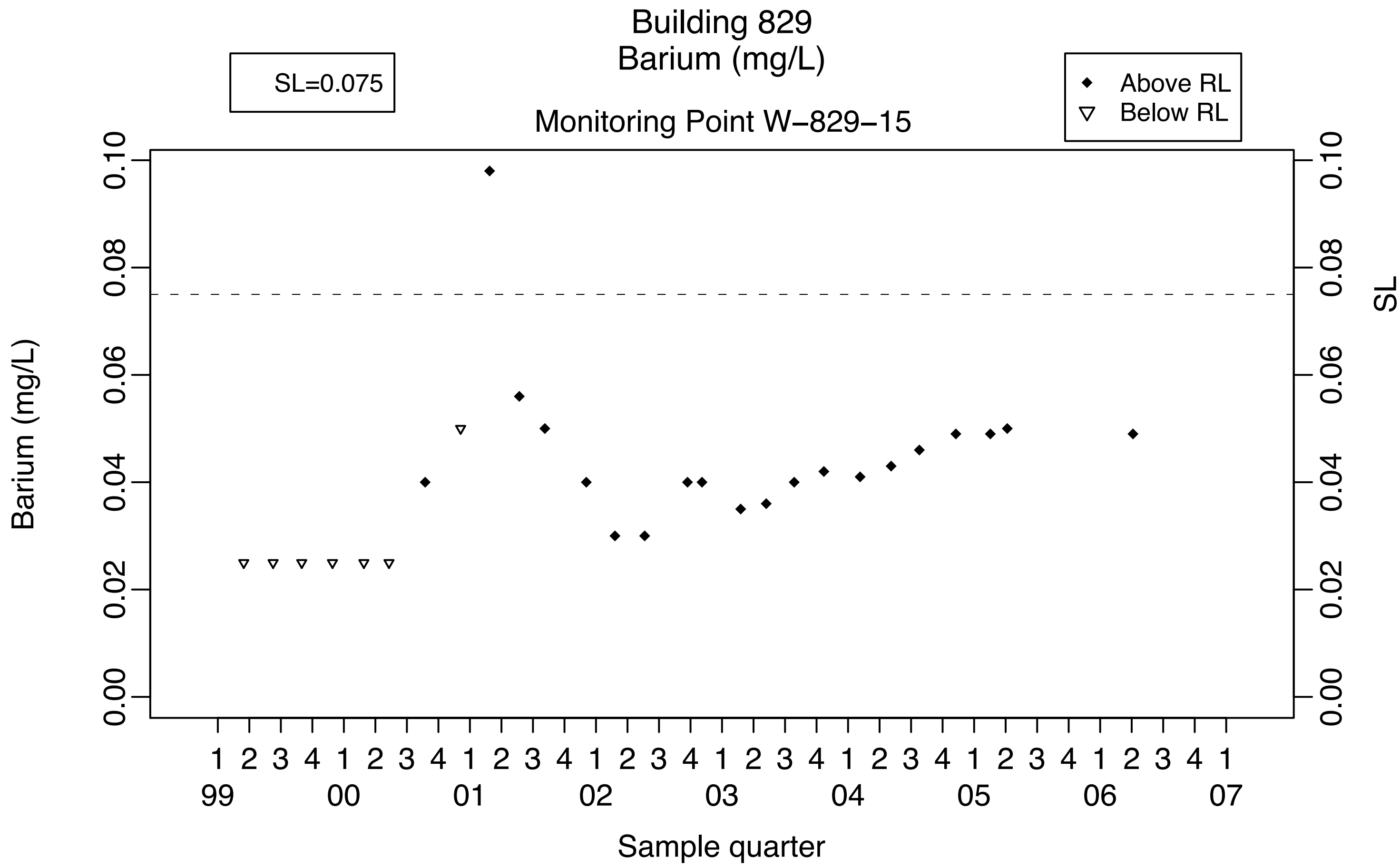


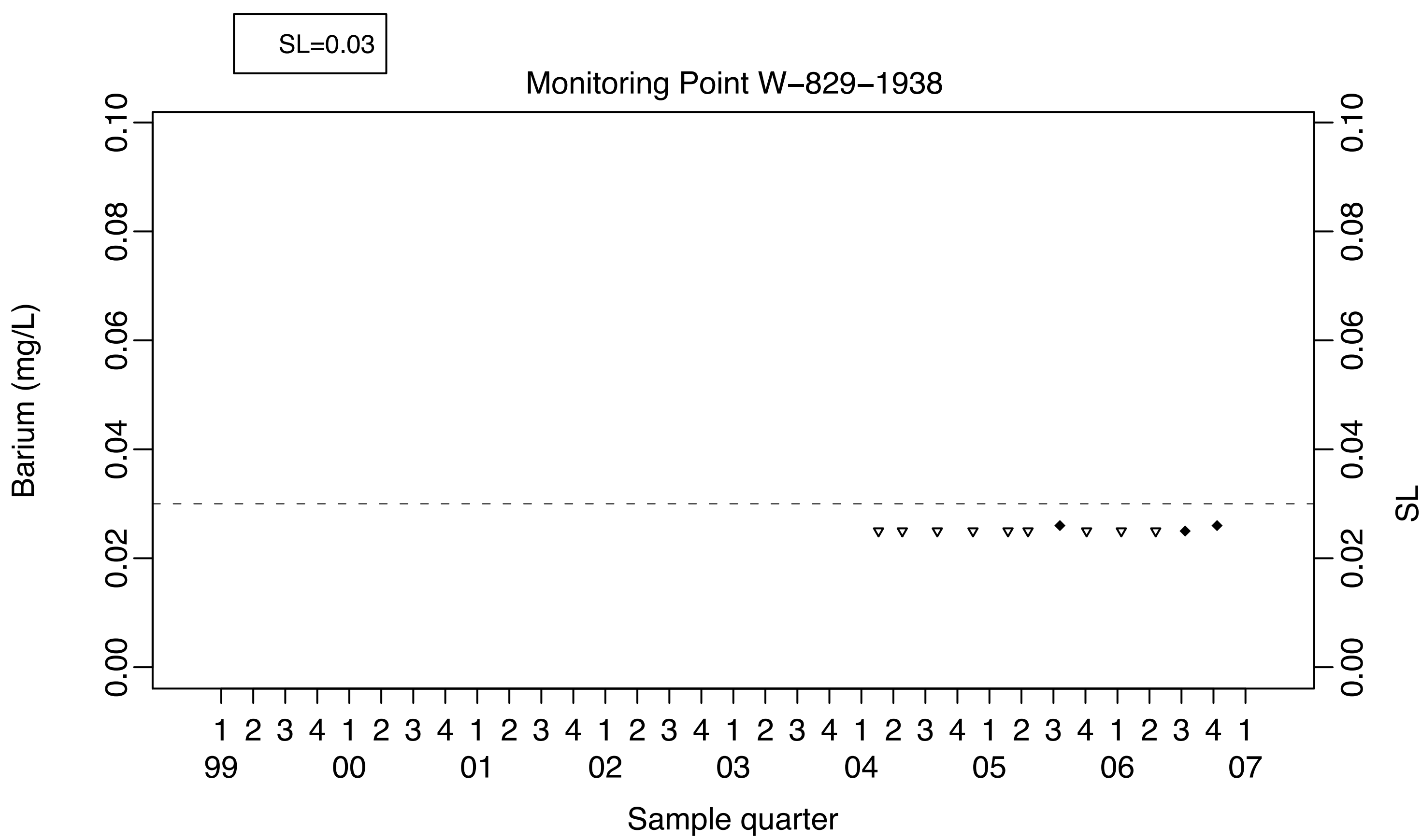
Building 829
Arsenic (mg/L)

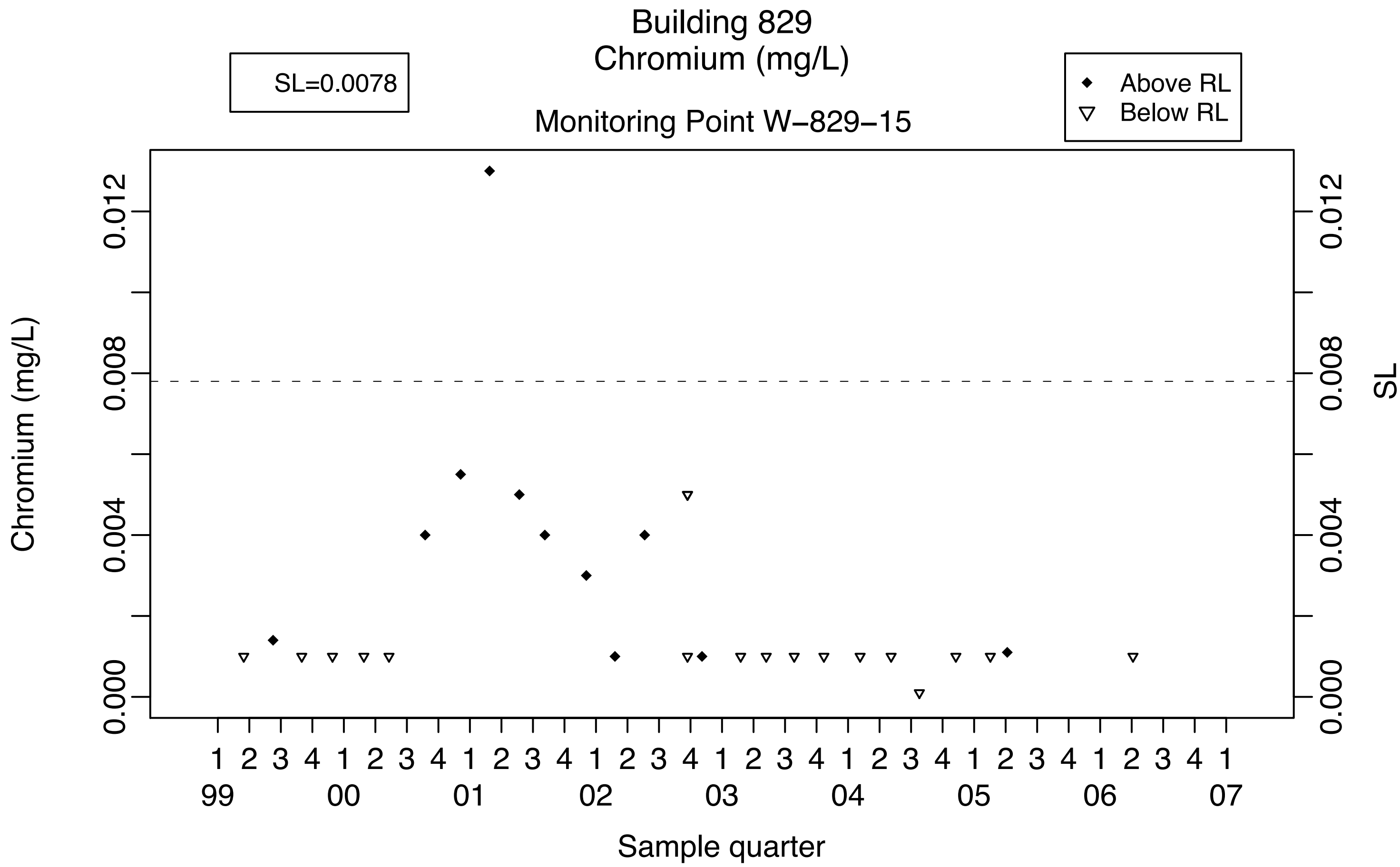


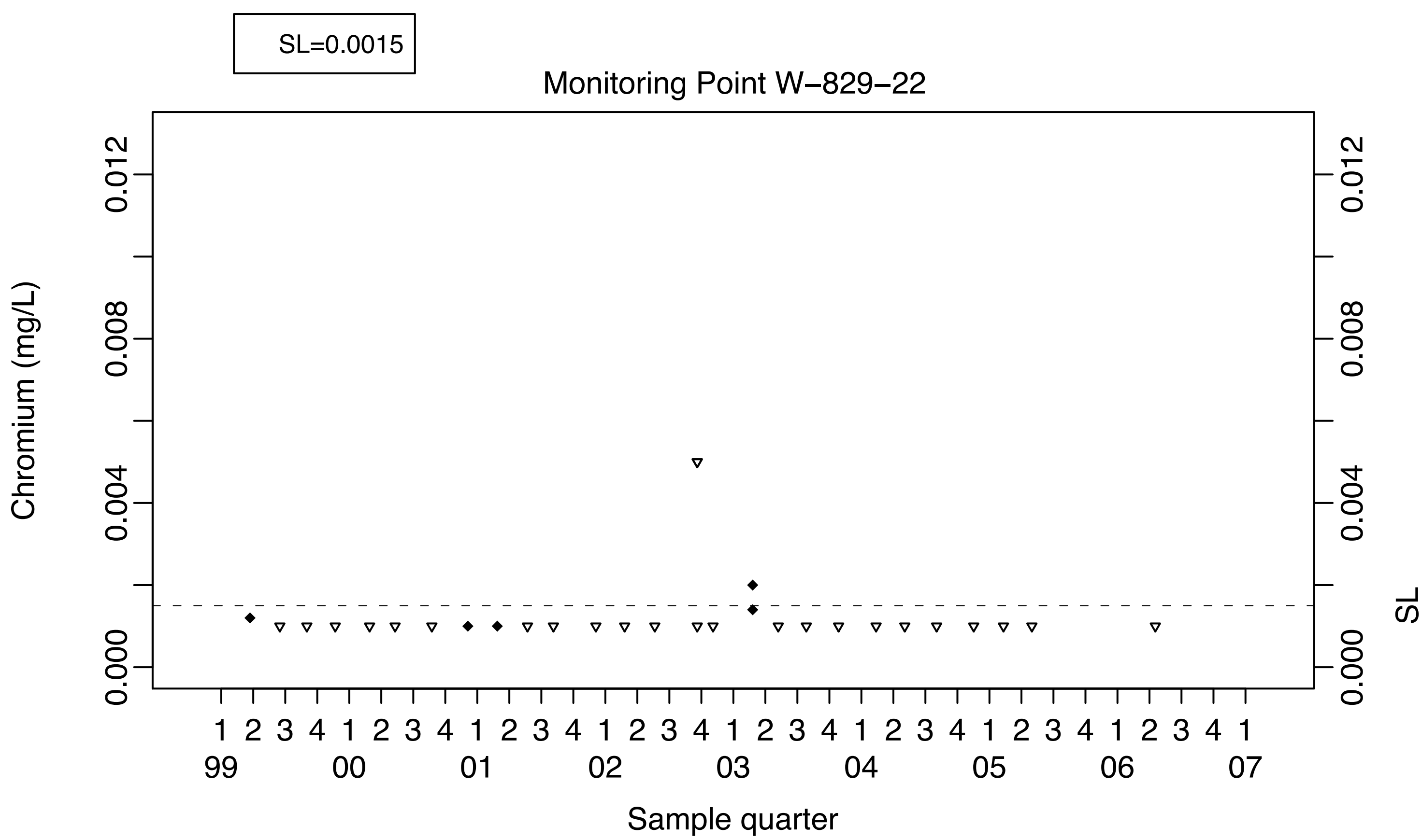


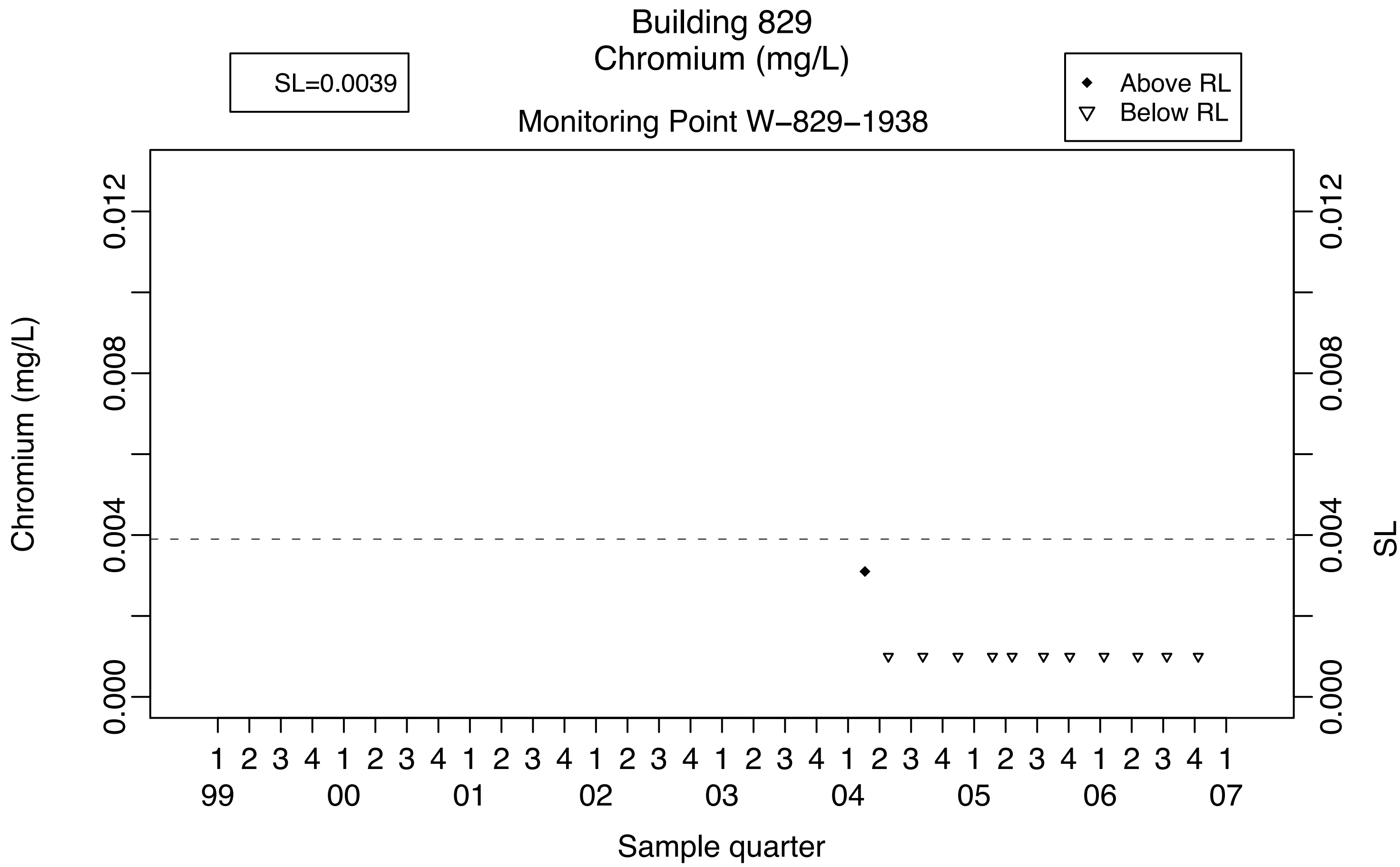

Building 829
Arsenic (mg/L)
SL=0.042
Above RL
Below RL
Monitoring Point W−829−1938
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99
00
01
02
03
04
05
06
07
Sample quarter

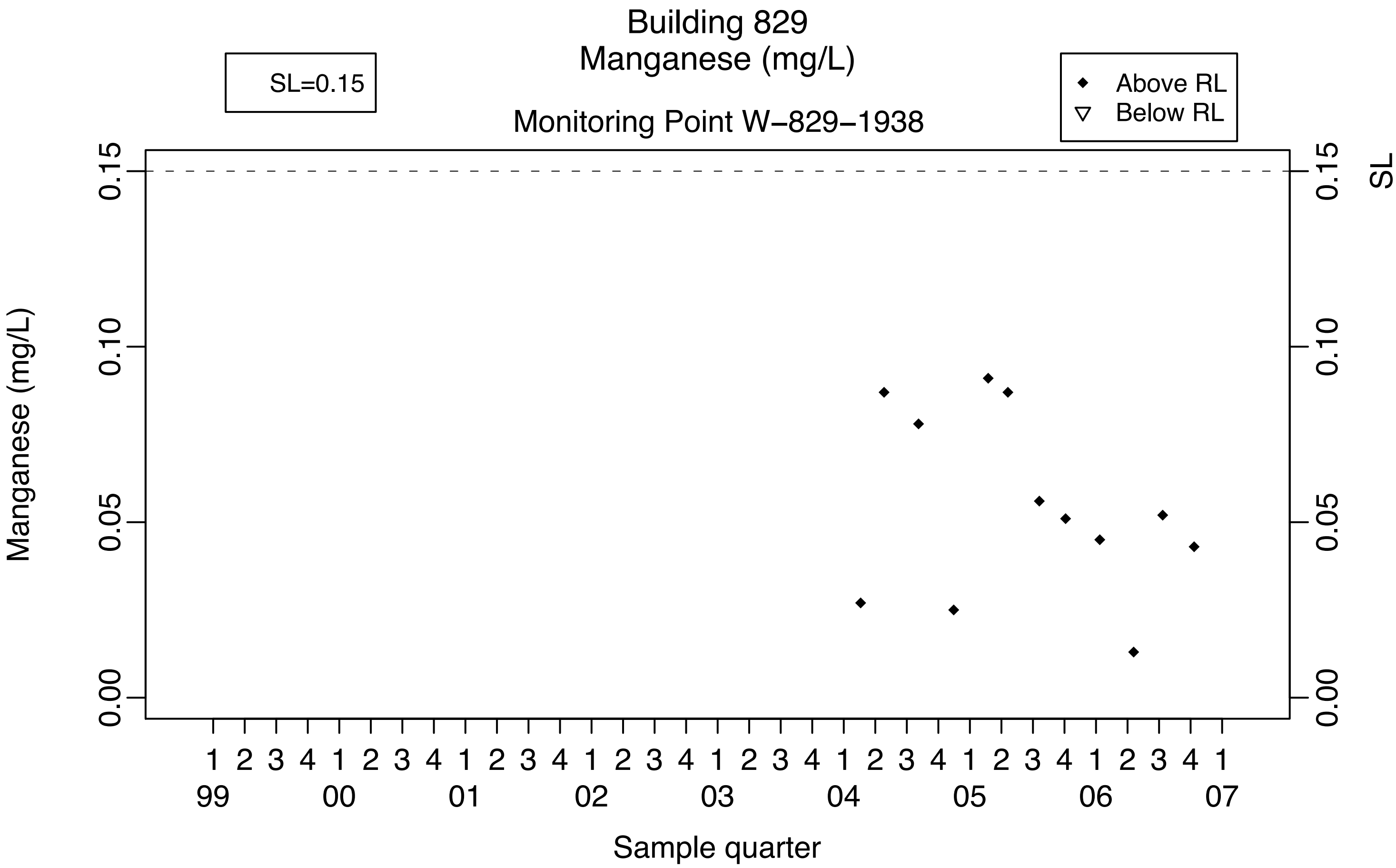

Building 829
Barium (mg/L)
SL=0.075
Above RL
Below RL
Monitoring Point W−829−15
Barium (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

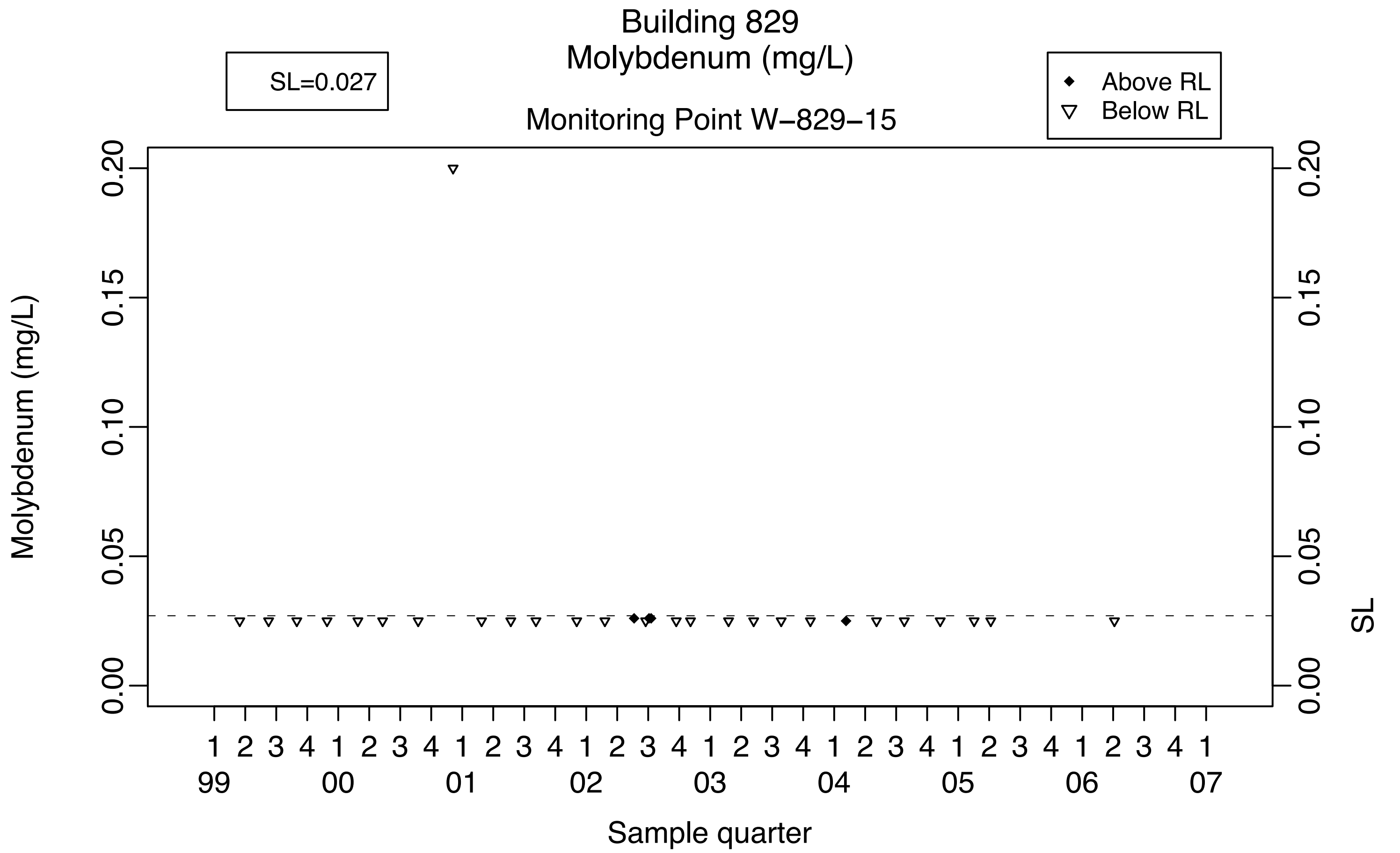

SL=0.03
Monitoring Point W−829−1938
Barium (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

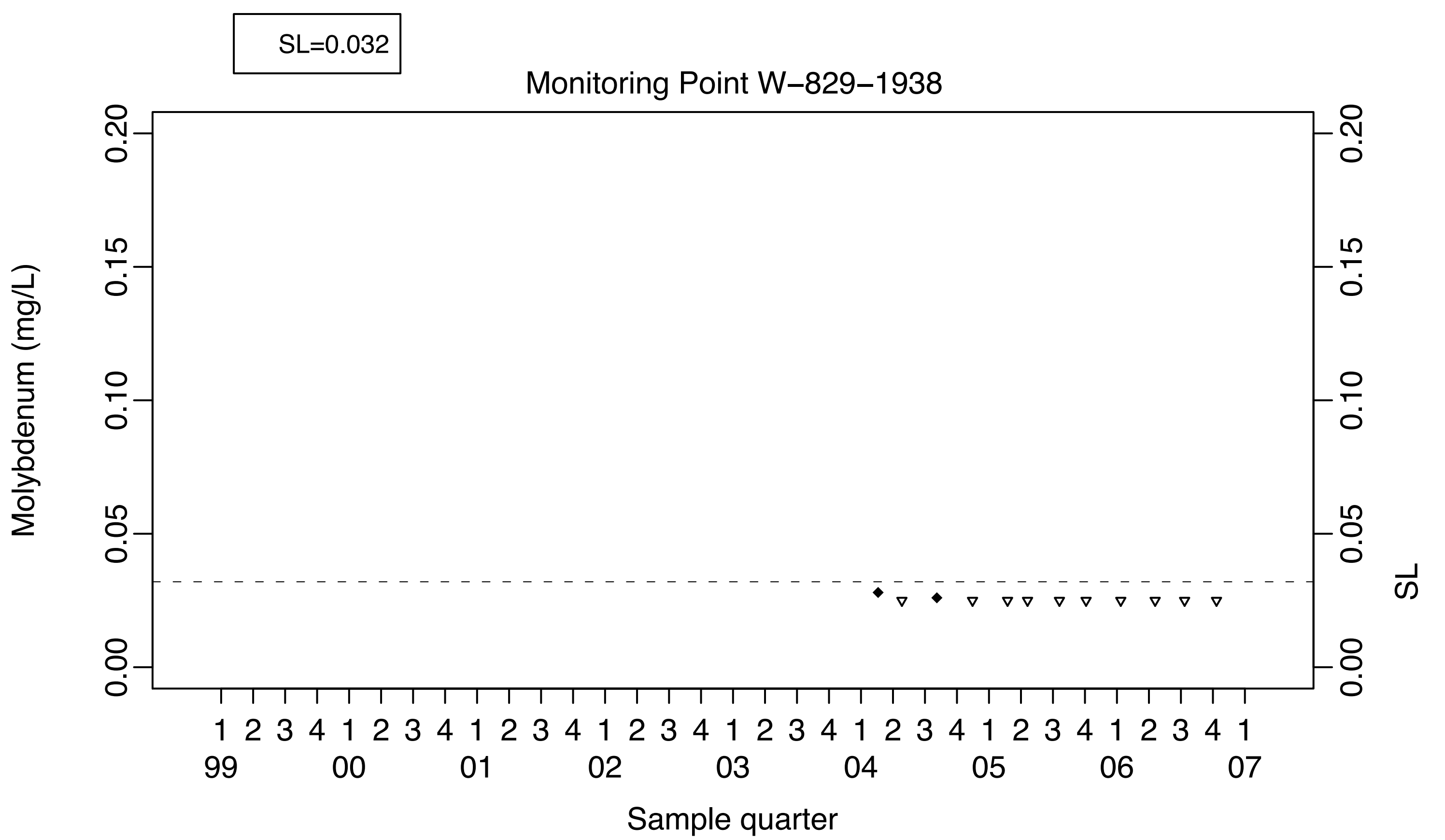

Building 829
Chromium (mg/L)
SL=0.0078
Above RL
Below RL
Monitoring Point W-829-15
Chromium (mg/L)
0.000
0.004
0.008
0.012
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

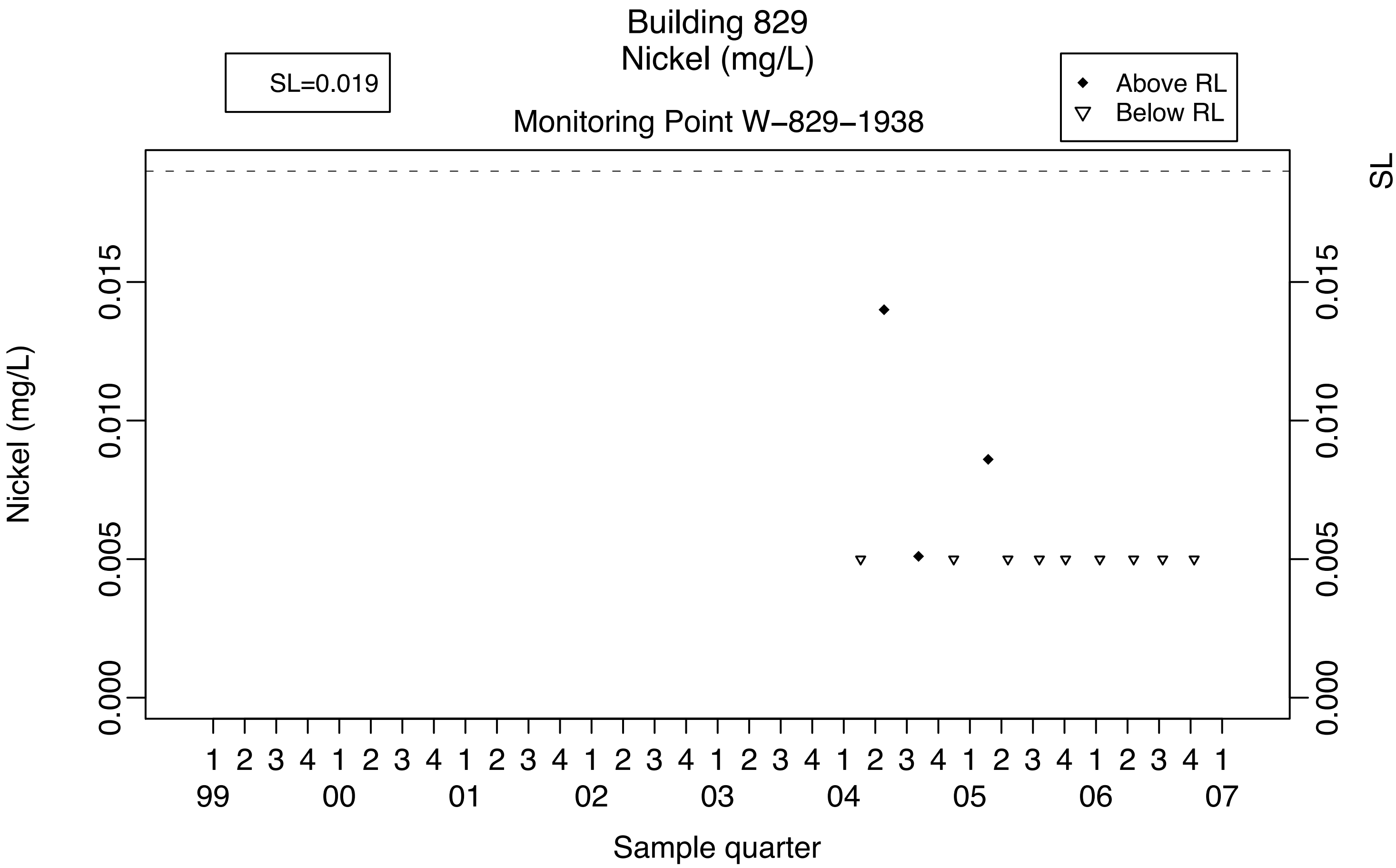

SL=0.0015
Monitoring Point W-829-22
Chromium (mg/L)
0.000
0.004
0.008
0.012
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

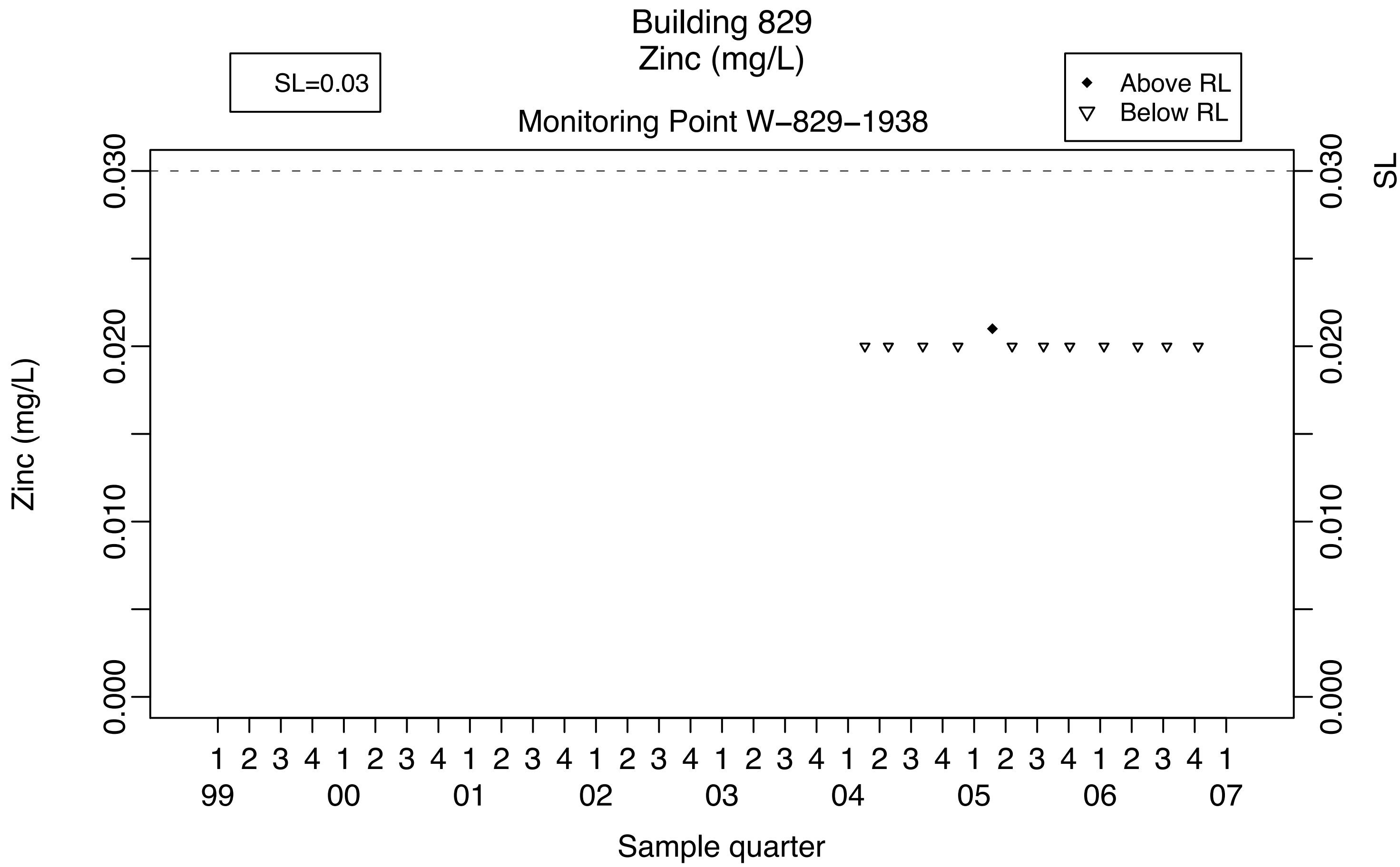

Building 829
Chromium (mg/L)
SL=0.0039
Monitoring Point W−829−1938
Above RL
Below RL
Chromium (mg/L)
SL
0.000
0.004
0.008
0.012
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

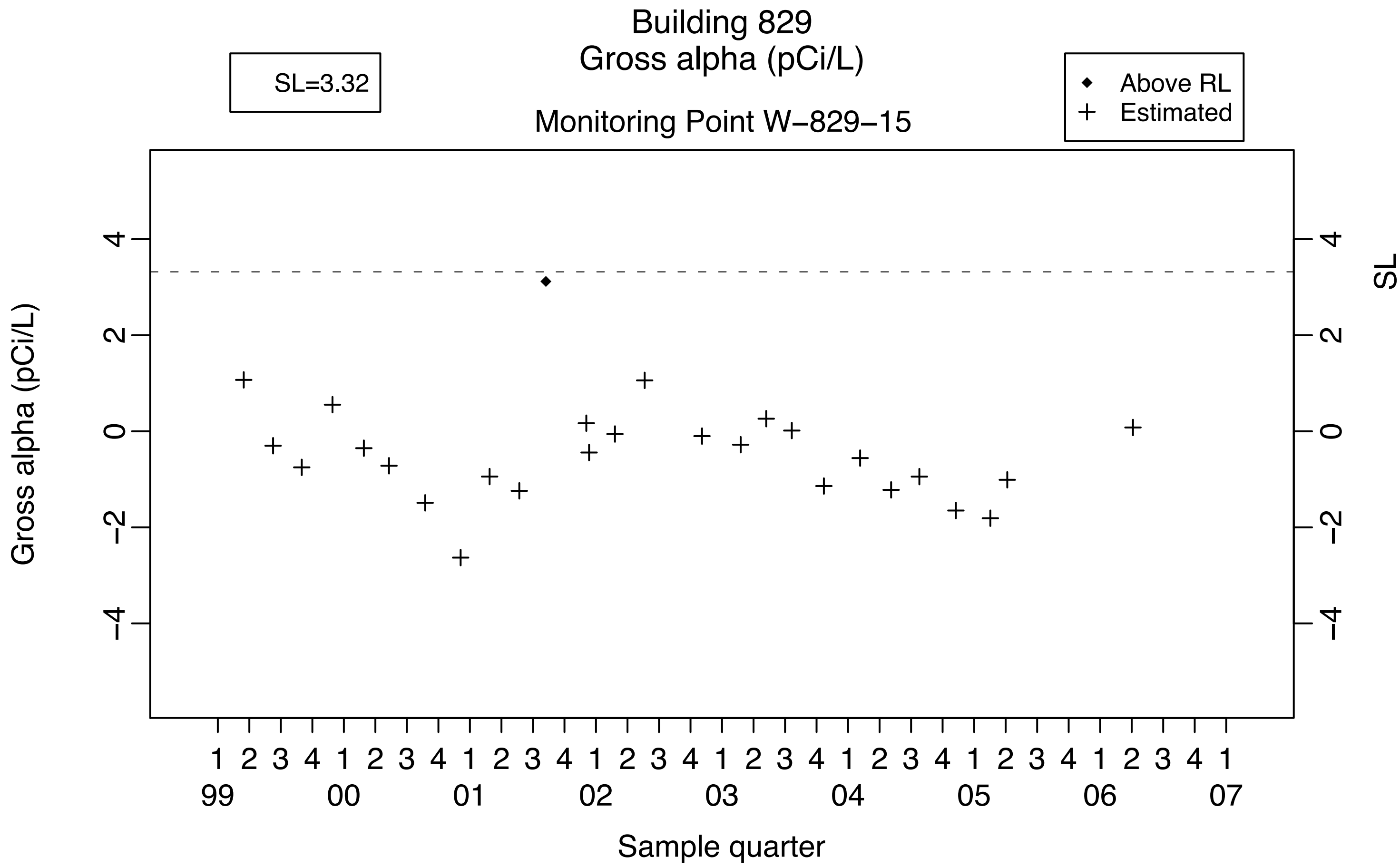

Building 829
Manganese (mg/L)
SL=0.15
Above RL
Below RL
Monitoring Point W−829−1938
Manganese (mg/L)
0.00
0.05
0.10
0.15
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

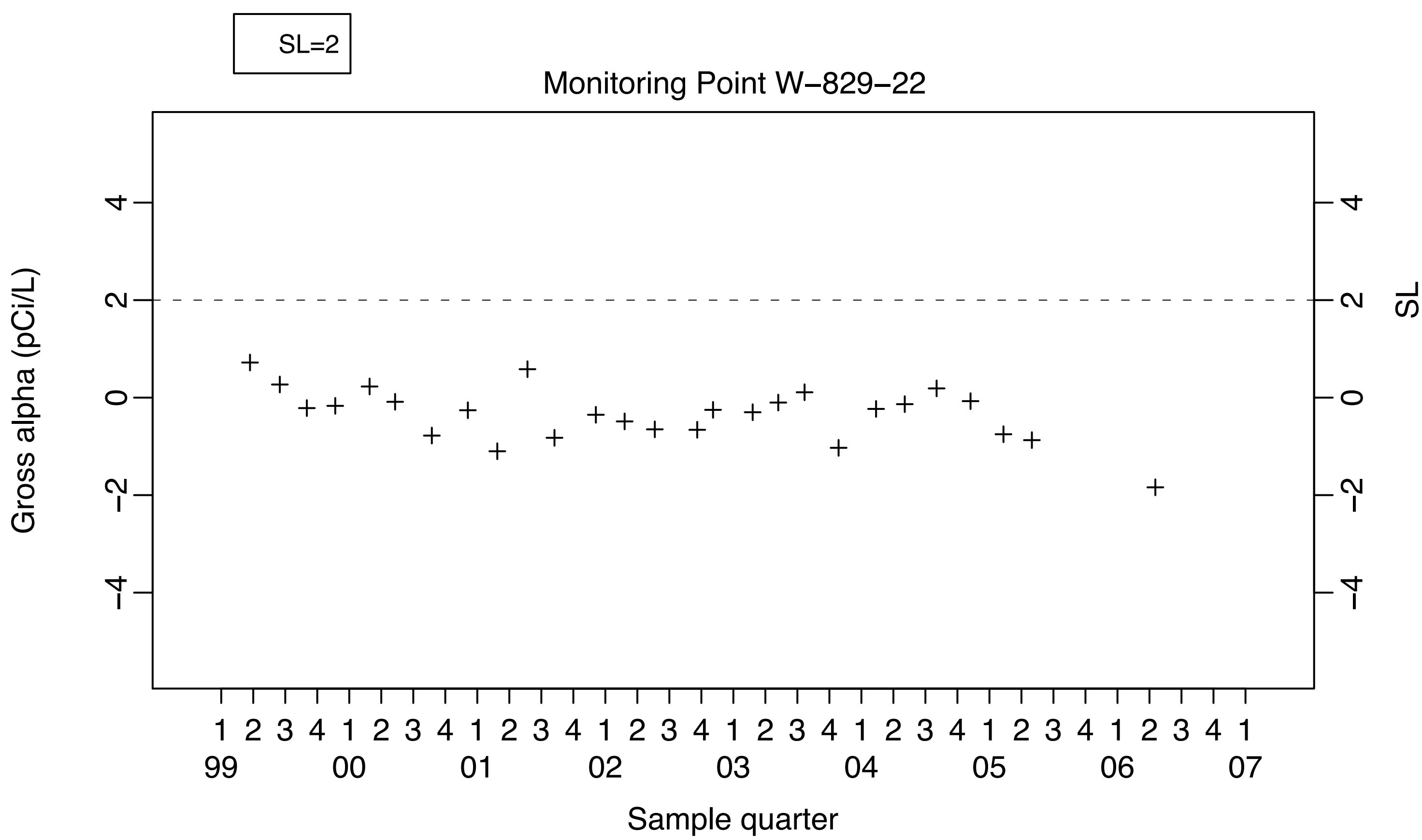

Building 829
Molybdenum (mg/L)
SL=0.027
Above RL
Below RL
Monitoring Point W−829−15
Molybdenum (mg/L)
0.00 0.05 0.10 0.15 0.20
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

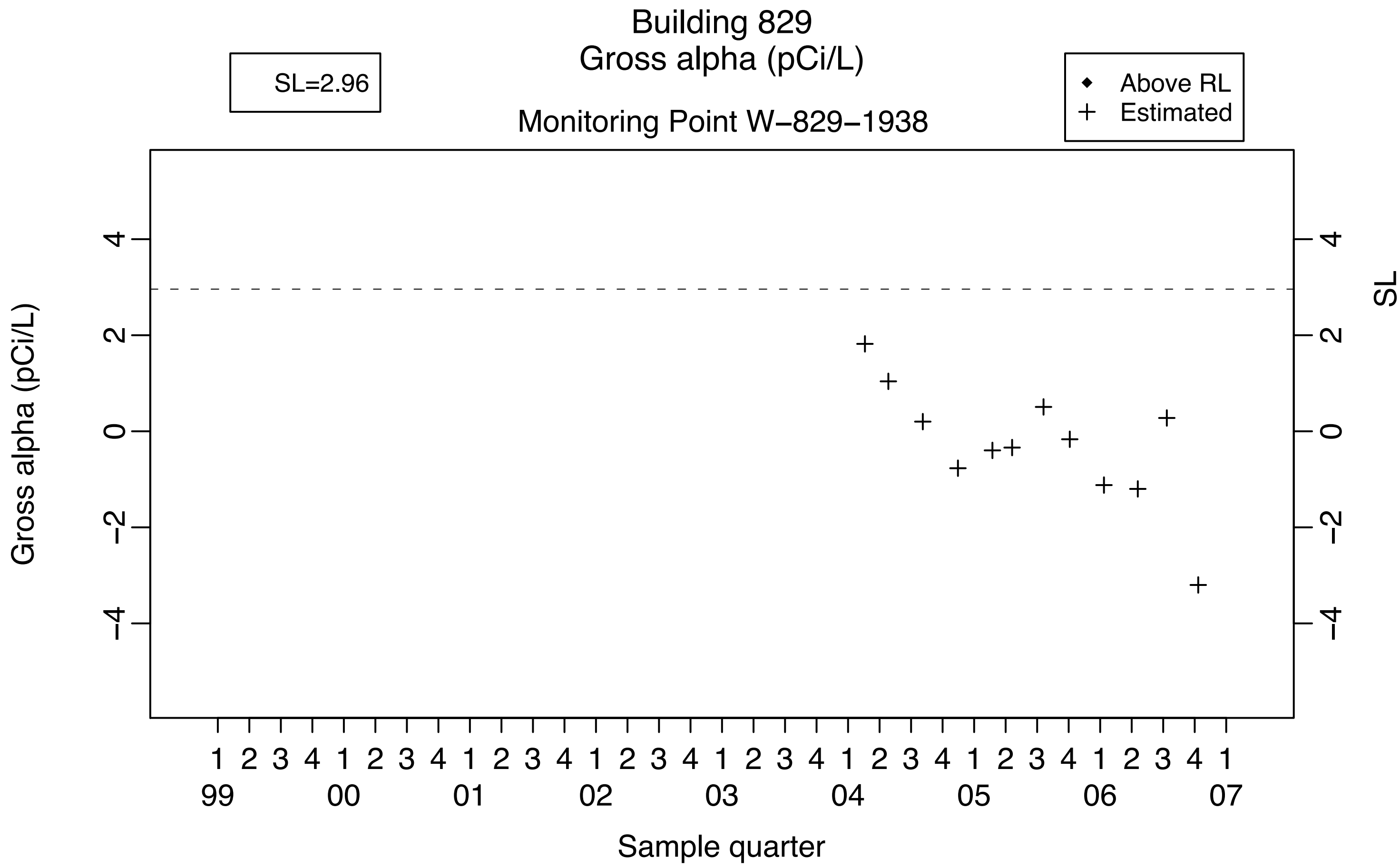

SL=0.032
Monitoring Point W−829−1938
Molybdenum (mg/L)
0.00 0.05 0.10 0.15 0.20
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter


Building 829
Nickel (mg/L)
SL=0.019
Above RL
Below RL
Monitoring Point W−829−1938
SL
Nickel (mg/L)
0.000
0.005
0.010
0.015
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

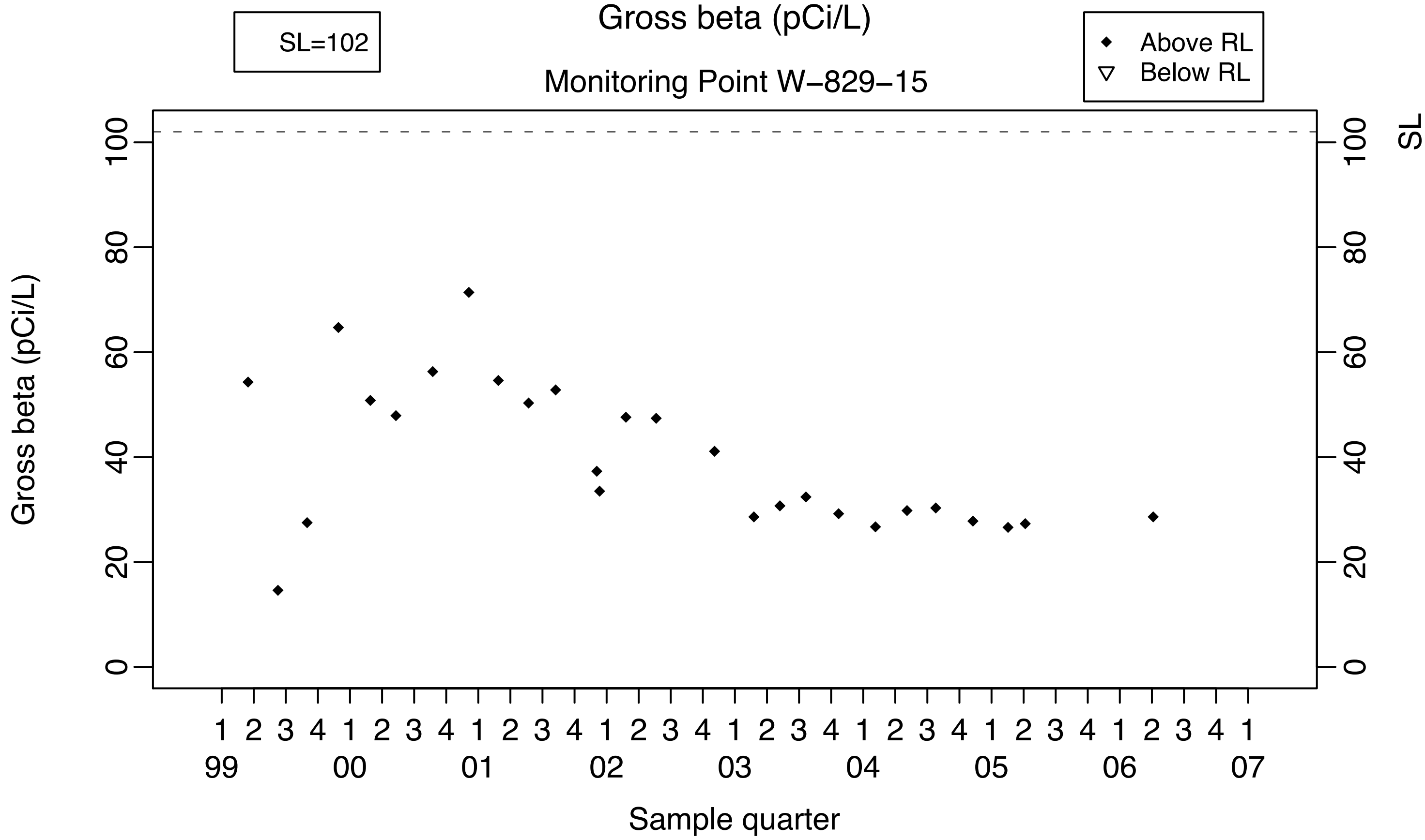

Building 829
Zinc (mg/L)
SL=0.03
Above RL
Below RL
Monitoring Point W−829−1938
Zinc (mg/L)
0.000
0.010
0.020
0.030
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

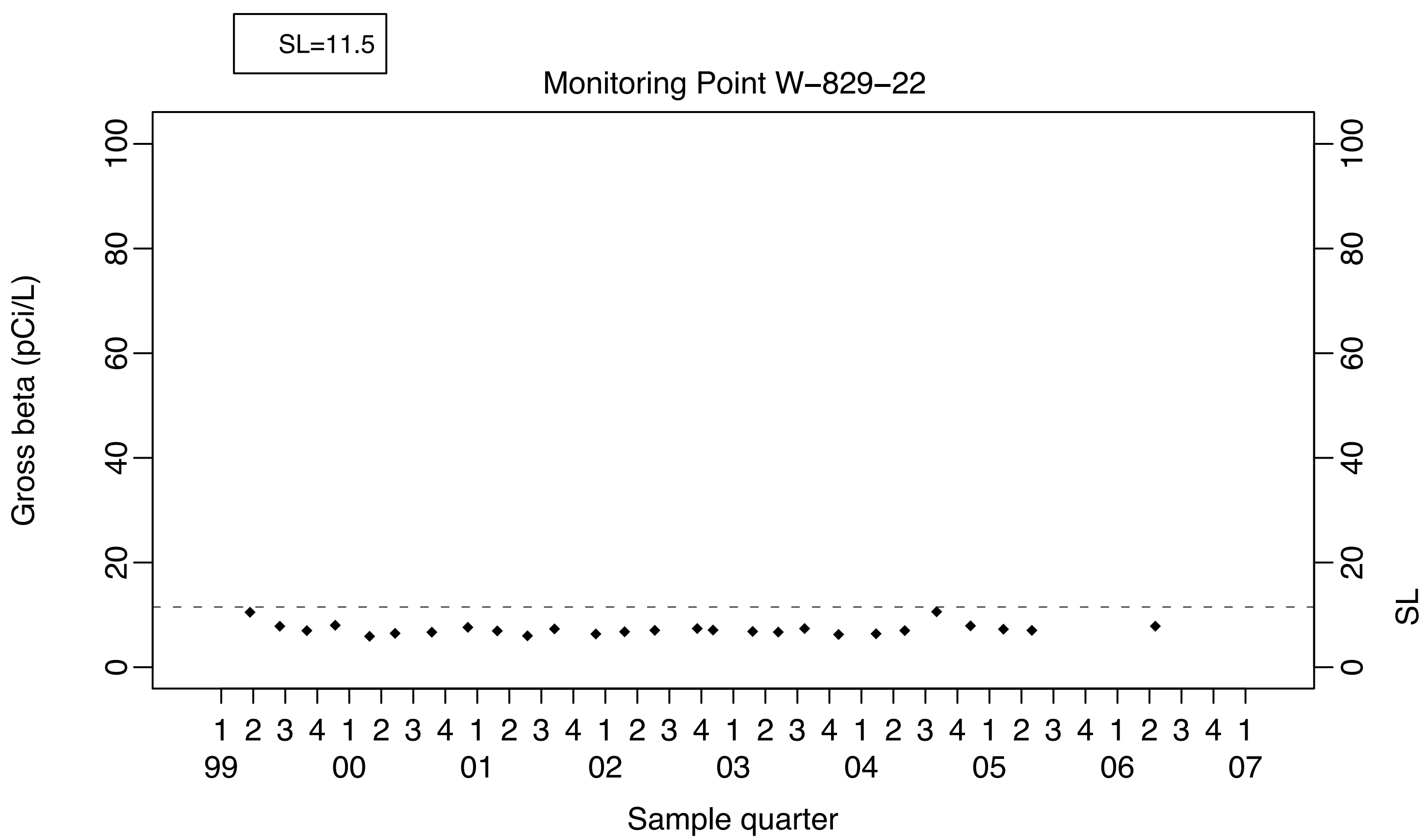

Building 829
Gross alpha (pCi/L)
SL=3.32
Above RL
Estimated
Monitoring Point W−829−15
Gross alpha (pCi/L)
SL
4
2
0
−2
−4
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

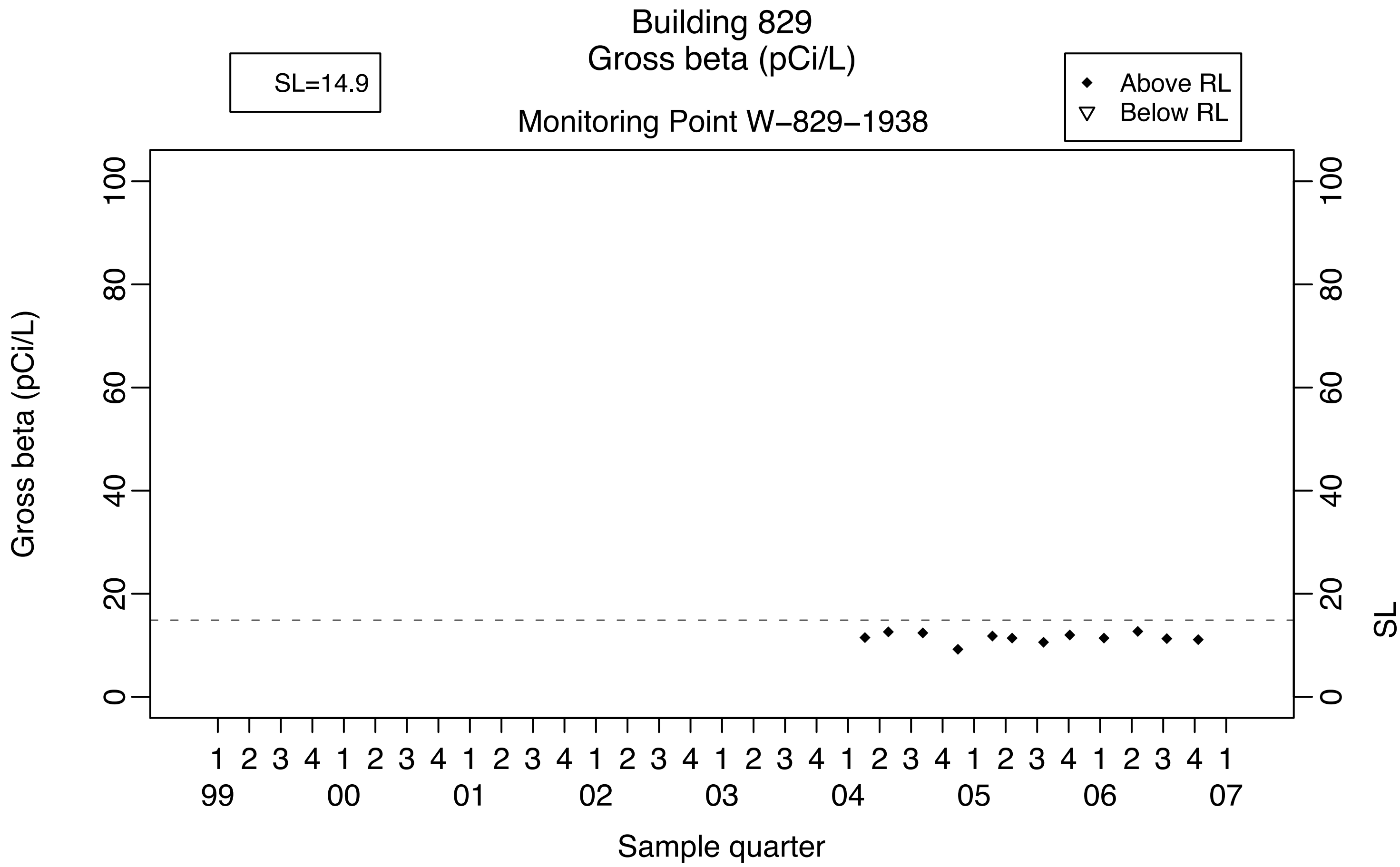

SL=2
Monitoring Point W−829−22
Gross alpha (pCi/L)
SL
4
2
0
−2
−4
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter


Building 829
Gross alpha (pCi/L)
SL=2.96
Above RL
Estimated
Monitoring Point W–829–1938
Gross alpha (pCi/L)
SL
4
2
0
–2
–4
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

Building 829
Gross beta (pCi/L)






Building 829
Gross beta (pCi/L)
SL=14.9
Above RL
Below RL
Monitoring Point W−829−1938
Gross beta (pCi/L)
0
20
40
60
80
100
SL
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
99 00 01 02 03 04 05 06 07
Sample quarter

Appendix B

LLNL Site 300 Building 829 Landfill Cap Annual Engineering Inspection

Abri Environmental Engineering, Inc.

Environmental Management and Compliance Consultants

LLNL SITE 300 BUILDING 829 LANDFILL CAP ANNUAL ENGINEERING INSPECTION

June 2006

CERTIFICATION

Based on the information reviewed, I certify that this annual inspection and evaluation report fairly describes the condition of the closed Building 829 Landfill.

I certify under penalty of law that this document and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete.

William W. Moore, P.E.
California Civil Engineer, No. 18,340

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Figures

Executive Summary

Abri Environmental Engineering has performed the annual inspection of the Building 829 landfill cap at the Lawrence Livermore National Laboratory (LLNL) Site 300 located near the City of Tracy. Mr. William W. Moore, P.E., conducted this annual inspection on May 24, 2006. Mr. Moore is a California Registered Civil engineer, with extensive experience in civil engineering, and hazardous waste management.

This report has been prepared consistent with the scope of work and in compliance with 22CCR Section 66264.228(K). The report is based on the observations made during the inspection and review of the documents listed below.

Building 829 Landfill cap is generally in good condition; the vegetation cover is relatively thick and covers the soil cap over the pits; there is no visible erosion of the cap; and the drainage system is in good condition and appears to be functioning as intended. The groundwater monitoring system appears to be in good condition as well. Some evidence of animal burrowing was observed. Recommendations on these observations are made below.

1.0 Introduction:

LLNL Site 300, EPA ID Number CA2890090002, is owned by the U.S. Department of Energy (DOE) and is operated jointly by the University of California (UC) and DOE. The Site comprises approximately 7,000 acres of largely undeveloped land and is primarily used as an explosives test facility. Site 300 is located 15 miles southeast of the LLNL Livermore Site, and 2 miles northeast of the City of Tracy, California, see Figure 1. About one-sixth of the Site is in Alameda County and the rest is located in San Joaquin County.

Building 829 landfill area is located in the southeastern corner of Site 300, See Figure 2. Building 829 area was used to burn explosives and explosive contaminated wastes at the HE Open Burn Treatment Facility. In 1997 LLNL closed the facility according to a DTSC approved RCRA closure plan. As a result the area was closed as a landfill with an engineered cap consisting of minimum of 2 ft compacted general fill, a layer of geosynthetic material and a minimum of 2 ft vegetative soil.

The inspection of the cap included walking the surface and perimeter of the cap. Weather conditions were sunny, temperatures in high 60's with winds 10-15 miles per hour.

In conjunction with the inspection, the following project files and documents were reviewed:

- Closure Plan for the High-Explosives Open Burn Treatment Facility at Lawrence Livermore National Laboratory, Experimental Test Site 300, dated July 1993,
- Annual Pit Survey Data from 2001 to 2005,
- Specification PCS-1227, Site 300 Building 829 HE Burn Pits Closure, dated September 1997,
- 1-12-05 until 3-22-06 monthly Post-Closure Inspection Checklist
- B829 Monitoring Well Inspection Checklist.

2.0 Inspection Observations and recommendations

The inspection of the cap included walking the surface and perimeter of the cap. The following sections describe the condition and recommendations.

The landfill had a 3 ft high retaining wall at the southwest corner of the cap. The wall appears to be in good condition and appears to be performing as intended.

2-1. Condition of Access Control (Fences, Gates and Warning Signs)

LLNL site 300 is a highly secured site with around the clock armed guards and perimeter fence. The entrance to the site is on Corral Hollow Road, which is secured by gates, fences and armed guards. Warning signs in English and Spanish were posted adjacent to the pits.

2-2 Condition of Vegetation

The landfill was covered with thick and well established vegetation, see figure 3.

2-3 Erosion

Due to the good vegetative cover, there is no erosion visible on the site.

2-4 Cracking

No cracking or other desiccation of the cover was visible during the site visit.

2-5 Disturbance by Adverse Weather

No erosion or other evidence of disturbance/damage due to adverse weather (i.e. freezing and thawing) was observed at the site.

2-6 Seepage

No evidence of seepage or discharge was observed beyond the existing collection structures at the facility.

2-7 Slope Stability

No indication of slope instability was observed. There were no sign of slumping or shallow, localized failure.

2-8 Subsidence

No evidence of subsidence was observed over the pit.

2-9 Settlement

Results of the annual pit survey data from 2001 to 2005 showed maximum settlement of .06 feet, with an average value of .03 feet across the pit surface area.

2-10 Condition of Groundwater Monitoring System

A review of groundwater monitoring inspection records indicated that the inspections were not conducted consistently during 2005. LLNL is in discussions with the DTSC for correcting the situation. No evidence of compromise in structural integrity of the groundwater monitoring wells was observed onsite or indicated in the existing inspection logs.

2-11 Condition of Run-On and Run-Off Control Systems

Surface runoff diversion structures consist of a perimeter drainage V-ditch. The V-ditch has expansion joints every 12 ft and every other one is caulked. The remaining expansion joints appear to be saw cuts partially onto the surface of the concrete. The structure also collects water from the "drainage layer" of the cap through a series of drainage pipes. Concrete lining appears to be in good condition. The ditch end at northeast corner is low and minor amounts of ponded water and vegetation is present, see Figure 4.

2-12 Condition of Surveyed Benchmarks

The settlement markers appear to be in good condition.

2-13 Burrowing Animals

There are few small burrowing animal holes, approximately 2 inches in diameter, on the cap. A few larger burrowing animal holes, approximately 8 inches, were observed primarily on the north side near the V ditch. It is recommended that holes exceeding 18 in. in depth and 6 in. in diameter be repaired.

2-14 List of recommendations for Building 829 Landfill

- Fill in the animal holes exceeding 18 in. in depth and 6 in. in diameter on the cap and reseed where necessary

Figure 1 LLNL Location Map

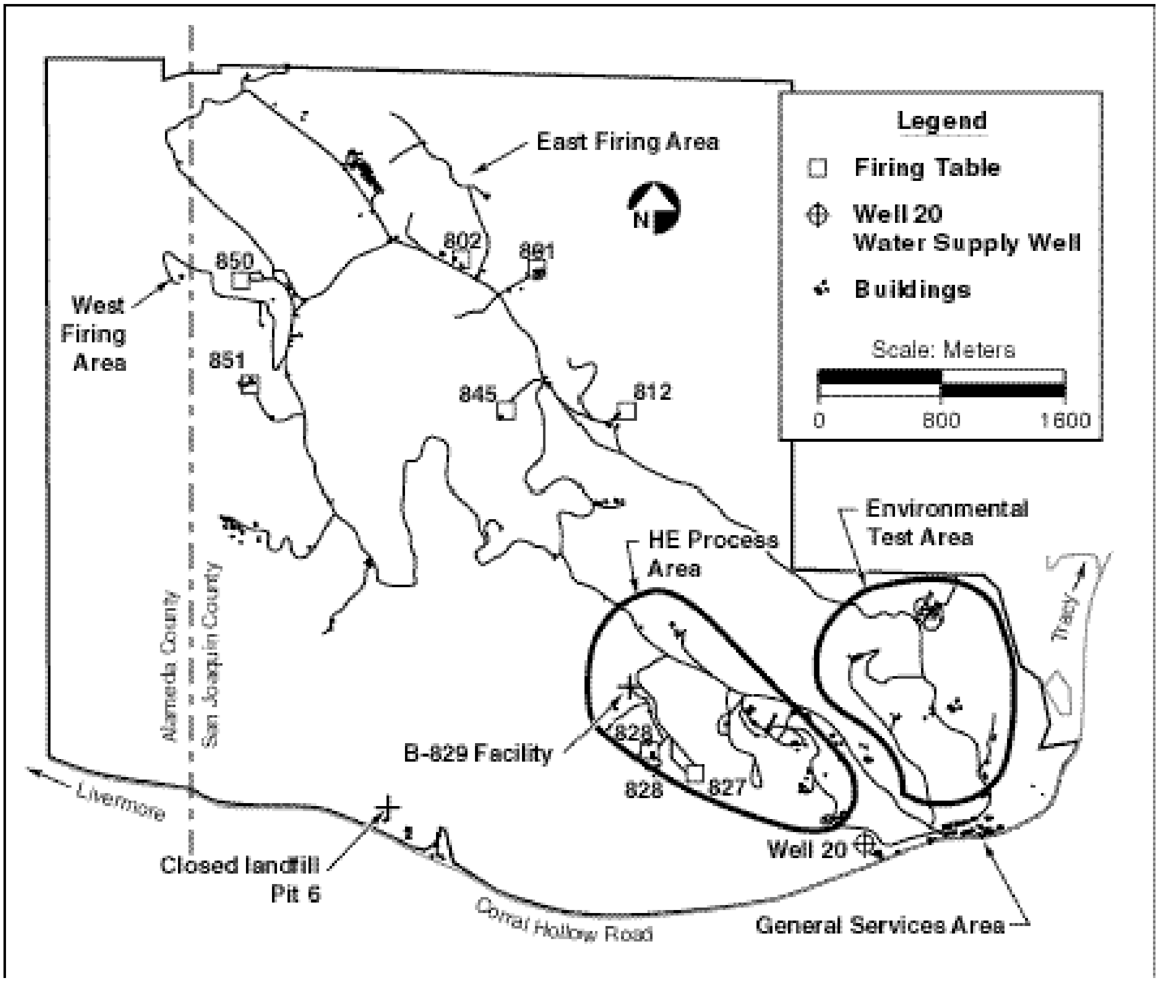

Figure 2 Building 829 Landfill Location Map

Figure 3 Building 829 Landfill

Figure 4 Building 829 Landfill Drainage Ditch

Appendix C

Acronyms and Abbreviations

Appendix C

Acronyms and Abbreviations

CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CL	concentration limit
COC	constituent of concern
CY	calendar year
DCE	1,2-dichloroethene
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
EPA	Environmental Protection Agency
GWE	groundwater elevation
HE	high explosives
LLNL	Lawrence Livermore National Laboratory
MPN	most probable number
PE	Professional Engineer
POC	point of compliance
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
SL	statistically determined limit of concentration
TCE	trichloroethene
VOC	volatile organic compound

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